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The CRITICAL MAKERS Reader

(UN)LEARNING TECHNOLOGY

EDITED BY
LOES BOGERS
LETIZIA CHIAPPINI

INC READER #12

Amsterdam University of Applied Sciences

The Critical Makers Reader: (Un)learning Technology

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Loes Bogers &
Letizia Chiappini

INTRODUCTION

LOES BOGERS & LETIZIA CHIAPPINI

In June 2019, Maker Media announced that it had laid off its entire staff and ceased its operations. Over the last 15 years, the company had successfully positioned itself as the face of a self-proclaimed 'maker movement'. It had celebrated making, tinkering, and DIYing with technology as educational leisure activity. It had organized local showcases and written detailed tutorials for your next project, that crazy cyberpunk clock or smart weather station. Its signature MAKE magazine had provided the guides for choosing (read: buying) your next dev board or 3D printer, allowing you to finally build that retro camera or automate your home in your spare time. Maker Media's popularity and influence have been undeniable, but not uncontroversial. Its ideology, lack of diversity, and strategic choices (such as accepting DARPA funding), were subjected to critical scrutiny from practitioners within the maker realm as well as the hackers, artists, and cultural critics in adjacent fields.

The death knell of Maker Media gives us pause. It provides us with a moment to reflect about making practices, about the ideologies and imperatives built into this so-called movement. What constitutes better stuff when it comes down it, when we examine the essence of how things are made and embedded into a social, economical, cultural, political, and ecological fabric? Slick promises and good intentions often obscure a non-solution with more undesirable and unintended consequences than you can fit on a product poster. Nevertheless, you too can build this – provided you can spend €150 in sensors, boards, and acrylic sheets, and have the luxury of at least two weeks of free time to learn new skills and visit a local makerspace within their limited (or non-existent) public opening hours. Who benefits from this making and who doesn't? During the giddy rise of Maker Media-style making, these basic questions were passed over or waved away with user research and agile methods involving mostly corporate stakeholders.

But the gravesite of Maker Media might also be a garden, sprouting the early shoots of a new critical making. Makers are increasingly shaking off their initial blind enthusiasm to numerically control everything, renewing an interest in sociocultural histories and futures, as well as the environmental and economical implications of digital machines for subtracting, adding, transforming, and connecting materials. Whereas a decade ago many gaped starry-eyed at the possibilities of 3D printers and other DIY tech, a critical mass now points out that no service, tool, or piece of software is good, bad, or neutral – or even free for that matter. Your cheap hardware from China is costing someone else their health and soil. In response, new critical initiatives are emerging in the shape of feminist makerspaces, local communal electronics depots, repair and upcycling communities, and research and education platforms centering around sustainable materials and open-source tools.

We've arrived at a crossroads. What was making? What is making? And perhaps most critically, what could making become? These are the questions this anthology investigates.

The Maker is Dead. Long Live the Maker?

Shortly after the news of MAKE's demise, a discussion erupted on the net-time mailing list, a critical eulogy that identified some strengths while pointing to many issues. Garnet Hertz took issue with the brand's mission to transform preexisting DIY maker practices into a commercial franchise. 'MAKE did a ton to help out this scene', he admitted, but they also 'whitewashed a lot of interesting things (experimental art, hacktivism, strange design work, hacker culture, interactive art, electronic music etc) – their paradigm of the franchise 'was an odd fit for DIY culture'.[1] The making we had was one commodified version, one possibility in a constellation of broader making practices.

Others debated the maker's position in the creative economy. While the products created may have had limited economic viability, perhaps this was not the main issue. Richard Sewell argued that there is always value in learning through making. 'The greatest value of the maker movement has been an explosion of people making things that don't entirely make sense and are not intended as commercial ventures', he asserted, 'That's not an issue, that's the point. They are learning to envision things and then make them and then learn from them, and they are making their own marvels'.[2] Making is a process and a practice, not just an outcome.

Others signaled the urgency of maintaining products and tools, and the importance of locally available resources to do so. For Adrian McEwen, making should also be framed in terms of repairs. 'We are facing many challenges: the climate emergency, labour conditions, plastic everywhere, wealth inequality,' he observed, 'there's lots of work to be done [...] If we're repairing our products more, then every town will need a bunch of people who can design replacement parts and make the repairs [...] Open hardware will then have an advantage because the schematics and designs will all be ready available for that.[3] Making leans forward into a more broken and more hyperlocal future.

These posts provide an autopsy whilst trying to revive the maker's healthier organs. Can we really say the maker is dead? Hardly. The municipality of Amsterdam, for instance, is currently rolling out publicly available shared makerspaces in the city's public libraries to facilitate 21st century learning and 'citymaking' for children by teaching them how to use CNC machines such as laser cutters and 3D printers. On the other hand, tinkerers, toy makers, shop display producers, and other local creative professionals and amateurs in Amsterdam have seen co-working spaces with digital fabrication facilities pop up – often with the funding from that same municipality – and close business just a few years later, leaving questions of successful maker business models and their relationship to precarious labour and tensions with activist ideals largely unanswered.

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1 Garnet Hertz, 'The Maker Movement is Abandoned by its Corporate Sponsors; Throws in the Towel' Posting to nettime mailing list, 11 June 2019, https://nettime.org/Lists-Archives/nettime-l-1906/msg00028.html.

2 Richard Sewell, 'The Maker Movement is Abandoned', 12 June 2019, https://nettime.org/Lists-Archives/nettime-l-1906/msg00050.html.

3 Adrian McEwen, 'The Maker Movement is Abandoned', 13 June 2019, https://nettime.org/Lists-Archives/nettime-l-1906/msg00053.html.

Perhaps it is education, above all, where making has exerted the most influence. 'Some of our best successes', stressed MAKE CEO Dale Dougherty, 'are in education'. 'The company is failing as a business but not as mission', he claimed, leading him to wonder if the company should reform as a non-profit.[4] Tutorials and sample projects on platforms like Instructables and MAKE have played an influential role in education, scaffolding the technological learning advocated in STE(A)M education paradigms in K-12 education in the US, and primary and secondary education of young people in Europe. However, pedagogies to adequately educate are still under review or awaiting a much-needed critical update. 'I see a potentially interesting/exciting new direction that could come of the dissolution of MAKE's stronghold in the realm of education', notes Minka Stoyanova; rather than simply 'teaching electronics to kids', tech education could include 'teaching critical approaches to technology, teaching media literacy, critical thinking, and environmental thinking'.[5]

While this foray into education was (arguably) successful, it also contributed to creating a population of makers lost without step-by-step project tutorials (Instructables), ready-made kits (Arduino or other dev boards), plug-ins and proprietary software (Adobe suite, Rhinoceros). Many beginning makers expected ideas-on-demand and immediate technical success, lubricated with easy-to-use software tools that seamlessly connect to one another. These padded conditions obscured how vectors, gcode, and transistors actually operate – and how such technologies might intersect with economic, legislative, political, and cultural developments. MAKE's culture, Chris Csikszentmihalyi concludes, 'encouraged a false consciousness that might change *how* but not *what* is made'.[6] In this environment, any potential to alter or appropriate a tool's functionality was overshadowed by the seemingly endless possibilities offered by the default settings. Too often, form followed a limit set of predefined functionalities, resulting in everything looking the same. The creative became cookie-cutter.

Such critiques resonate with our own discontents as researchers and educators. In these roles, we have studied the role of makerlabs in urban economies in Italy and the Netherlands[7] and taught in the digital fabrication workshop of an applied university. These activities have meant grappling with how making might slot into education. In 2017, a transdisciplinary semester course named *Makers Lab: Making as Research* was developed to bridge higher maker education informed by critical conceptual thought.[8] This process of designing a maker course was significantly inspired by participating in Fab Academy, a globally standardized training course that takes place in local FabLabs like the one here in Amsterdam.[9]

4 Josh Constine, 'Maker Faire Halts Operations and Lays off All Staff', *TechCrunch*, 7 June 2019, https://techcrunch.com/2019/06/07/make-magazine-maker-media-layoffs/.

5 Minka Stoyanova, 'The Maker Movement is Abandoned', 14 June 2019, https://nettime.org/Lists-Archives/nettime-l-1906/msg00062.html.

6 Chris Csikszentmihalyi, 'The Maker Movement is Abandoned', 10 June 2019, https://nettime.org/Lists-Archives/nettime-l-1906/msg00028.html.

7 Letizia Chiappini (one of the editors of this volume) conducted a comparative analysis in Amsterdam and Milan as part of her PhD research at the University of Amsterdam and the University of Milano Bicocca.

8 Developed by Loes Bogers (one of the editors of this volume) and Shirley Niemans, http://minormakerslab.nl/.

9 See also: https://waag.org/en/project/fab-academy.

These firsthand experiences revealed the double-edged nature of making. Those who could invest the time and money to participate learned to develop highly technical prototypes from scratch: from creating molds to designing and milling PCBs. Careful tinkering with materials, electronic components, and digital fabrication processes provided an embodied understanding of technologies and their inherent malleability. There are endless ways to connect and disconnect things, to configure and reconfigure objects. But it also taught us that there are tradeoffs – whether cognitive, emotional, aesthetic, sociocultural – when negotiating the affordances of tools and materials. Such knowledge seemed particularly fitting for polytechnic higher education and applied research. But is there a strut missing from this educational framework? Besides practical technical know-how and material knowledge, where are the critical conceptual tools that would enable learners to imagine and develop maker projects that can address the pressing political and ecological issues of our time?

In the process of putting together a syllabus for the course, it became clear that these questions had also been asked in the Critical Making described by information scholar Matt Ratto[10] and the more object-centered strand developed by artist and designer Garnet Hertz.[11] Hertz calls to re-politicize maker culture by pointing to the deficiencies and problems with making and the maker identity as successfully marketed by Maker Media. Critical Making and related approaches like Critical Technical Practice instead seek to produce objects that uncover injustice, highlight discrimination, and point to issues of power such as gender inequality, surveillance, racism, and human rights. The aim is not simply to critique from the outside, but to assess how one's own disciplinary framework and professional habitus might be contributing to such inequalities. Such approaches highlight the potential of making for generating knowledge and creating new critical perspectives. These, in turn, have consequences for the way we imagine, position, and organize physical spaces for making and whose agendas they should serve. They carve out a particular discursive space for makers to grapple with our broader, messier array of contemporary problems. Rather than Silicon Valley solutionism, they urge us to stay with the trouble.

The cultural practices MAKE drew upon, like DIY electronics, have existed much longer than the brand. The company attempted to incorporate a scene of cultural producers, technical practitioners, and casual hobbyists under the banner of makers. But in doing so, they largely reduced making to technological tinkering for empowerment-entertainment, mainly for an already powerful and affluent Western middle class. While often ignored, making always intersected with class in a particular way. This relationship between class and making has been leveraged strategically and politically before. One way to understand the maker phenomenon is the latest incarnation of a longstanding drive to monetize 'non-discursive technical cultures' which can be traced back at least to the Enlightenment, as Graham Harwood points out.[12]

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10 See for example: Matt Ratto, 'Critical Making' in Van Abel, Bas, et al. *Open Design Now: Why Design Cannot Remain Exclusive*. Amsterdam: BIS Publishers, 2014.

11 Garnet Hertz (ed.) *Critical Making*, Telharmonium Press: Hollywood, 2012, http://conceptlab.com/criticalmaking.

12 Graham Harwood, 'The Maker Movement is Abandoned', 11 June 2019, https://nettime.org/Lists-Archives/nettime-l-1906/msg00033.html.

In its universal global vision, the MAKE version of maker culture excluded a plethora of other practices and perspectives. It ignored historical linkages to politically engaged and activist creative technical practices developed in hackerspaces and (media) art collectives. It failed to address the problematic inheritances of its gendered and colonialist past and present. And it broke its promise of generating jobs and intervening in exploitative capitalist modes of global production. As Alice Yang reminds us: 'Most of the actual makers of our electronic products are women of color working in factories in the third and developing world.'[13]

The end of MAKE signals a moment in which we might wonder how to fill the institutional/educational hole it leaves behind, and how it might be filled without falling in the same traps. But critical making has a legacy of its own that is informing the way courses in universities and art academies are structured. This presents us with an opportunity to take stock of a decade of critical making by revisiting the original ideas behind the term – by looking both sideways and ahead. Who is the maker today, what is being made, and who benefits from contemporary makerly labour? And most importantly: what should be the next step?

This anthology gives space to critical makers to imagine the futures of their labs, tools, material engagements, and knowledge production. Do we need updated models for thought and practice? An open source based commons? New institutions or ways of instituting and organizing? Different business models? Other avenues and contexts for engaged technical practice? These questions take center stage and invite you to join the conversation: in class, online, and in your (maker) communities. The goal of this book is to provide makers, students, and ourselves with an overview that is both accessible and theoretical. Written primarily from the perspective of engaged practitioners, we see it resonating with people from a range of disciplines. In doing so, we hope to provide a critically made book about critical making.

Structure of the Reader

This anthology features 26 contributions from designers, artists, hackers, makers, and crafters, as well as activists, theorists, and scholars reflecting on contemporary maker cultures. Throughout the book, we've consciously decided to avoid any hard distinction between theory and practice. Some contributors describe in more detail how theory has informed their practice, while others flip this equation, explaining how their practice has led to different concepts and models for thinking. The reader is invited to draw further connections between the overlapping or even entangled contributions. The overture of the book is offered by Critical Making pioneers **Matt Ratto & Garnet Hertz**, who trace the intellectual genealogy of the term while reflecting on their own pedagogical practices in interdisciplinary learning. The sections that follow are organized into the following four themes:

13 Alice Yang, 'The Maker Movement is Abandoned', 12 June 2019, https://nettime.org/Lists-Archives/nettime-l-1906/msg00043.html.

Matter that Matters: Material Engagements with a Cause

In the face of climate change, surveillance capitalism powered by blackboxed 'smart' technologies, and the simultaneous material turn in the humanities, theories of making are being articulated anew. The anthropocentric character in Western thought and practices has been seriously called into question. After all, look at where the 'progress' of our supposedly productive design and engineering tendencies have led us. Whether stemming from older theological thought or newer neoliberal mantras, the imperative of the human to command and control, to dominate and domesticate, has become untenable. After the linguistic turn, reducing the world to social constructs shuts our eyes to its vibrant materiality, to the realm of active agents that shape, resist, and even speak through material difference (for those who know how to listen). Viewed in this light, making becomes a mutually transformative act between non-human and human, where material and discursive actors continuously come into being together.

The contributors in this section center around this kind of engagement, advocating for new articulations of critical making as a form of immanent critique. Rather than the all-too-easy debunking and complaining of the outsider, they acknowledge their position within. Here, thought is seen to have agency and action is always reflective (**Graham Harwood**, and **Maria Dada**'s post-critical counter-testimony of the maker). The more-than-human maker does not make from scratch, but engages material that coexists alongside her as always already-there. She is attentive to scale, to volume, and to the time of materiality. She oscillates between making and unmaking, shifting between the abstract and contextualized (**Critical Media Lab, xtine burroughs <> Lucy HG Solomon**). After the death of the neoliberal maker, feminist/new materialist and posthuman theory becomes a tactical guide for a more-than-human maker culture (**Gareth Foote and Eva Verhoeven**).

(Un)Learning Technology: Homo Faber's Tools

Contributors to this section highlight the potential of critical material engagements for learning about, but also with, technology. In this respect, they recall Matt Ratto's reminder that learning with and about technology should never merely be a means for priming (young) people for successful careers. These artists, designers, practitioners, and thinkers provide elucidating examples of projects across a variety of sectors in arts, design, and formal and informal educational environments. They attempt to critically unmake and remake machine learning algorithms (**Caroline Sinders**), discarded hard drives (**KairUs**), and electronic components (**David Cole & Hannah Perner-Wilson**).

The role of tools in processes of learning by making can be seen as a point of interest since constructionist models for learning were devised by Jean Piaget, Seymour Papert, and others. Vilém Flusser grappled with the mutually *in-form-ative* relationships between tools, makers, factories (or sites of production) and schools (or sites of learning), a set of conditions that allowed the figure of *homo faber* to emerge. Twenty years down the line, tools remain a point of interest, as authors assess what might constitute critical making in the context of architectural training (**Wim Nijenhuis**), design education (**Serena Cangiano**),

and laundry practices (**Samantha Penn**). These contributions problematize not only the tools but the larger sociocultural, ecological, geographical, and historical contexts they are embedded within. Nor we should forget that language itself is a tool, and inquire as to how the critical maker might challenge it (**Verena Kuni**). Can these discursive tools be unmade to reveal new productive forces? Perhaps critical making is most adequately defined as a simultaneously constructionist and diffractive process of learning: a tacit, material, *and* conceptual transformation.

Organizing Openness: Sociality and Community

Since the 2008 financial crisis, we have observed the rise of collaborative workspaces in cities all over the world. Creative workers, freelancers, and designers have gathered in coworking spaces, makerspaces, creative ateliers, and cultural hubs. The rise of such shared workspaces implies a break from the traditional division of labour set out by factories and offices. The spatio-organizational format of these new spaces is a response to the expansion of digital culture, where openness and sociality are considered requirements for any making practice. This culture is centered on open technology standards that are, in theory, accessible to anyone. Such free and open ideals originate from more established peer-to-peer practices within software development. The affordances and demands associated with these ideals have catalyzed new forms of organization of labour and production. For instance, in software production, the hierarchical and top-down organizational characteristics of factory production have started to be replaced by decentralized peer practices, as epitomized by the open source movement. Aspects of sociality and community created by these practices become crucial ingredients in the material production of objects and artifacts.

Given these shifts, some argue that what is missing in MAKE-style making is the role of the collective and critical action *beyond* the practice of making itself. This requires a critical look at how sociality might be appropriately contextualized, firmly situated in local communities and histories. The organizational practices of the Enkel collective provide one insightful illustration of how this might be carried out (**Benjamin Matthews**). Some practices intervene in the face of institutions, using tactics to trace the blackboxed physical and infrastructural components of Amazon Web services in Ireland (**Paul O'Neil**). Others show how self-organized communities interrogate housing databases to enable intervention and dissent in the context of urban regeneration in London (**Tom Keene**).

Contributors in this section address aspects of labour in relation to open design communities. They develop methods to destandardize design and challenge the prevalent concept of the universal user (**Deanna Herst**). They rearticulate the work involved in maintaining a sustainable open design commons (**Peter Troxler**). Of course, communities possess a certain class, a particular politics, a specific gender makeup. The role of these spaces of sociality in technical development, learning, and experimentation are discussed in the context of academia (**Krystin Gollihue & Abigail Browning**), and in a f(r)ictional dialogue between a hacker and a designer (**Anja Groten**).

Making Spaces: Labs, Institutions, and Autonomous Zones

Promoters of the Maker Movement designed a single vision and an overarching brand, attempting to draw together the corporate with the highly radical and autonomous. This global maker concept assumed that there is enough common ground between makers across continents to claim this common name. It assumed that you can 'make almost anything' with the same standardized set of tools. It assumed that internet accessibility is the same everywhere. And it assumed that the same set of values are largely transferable and universal.

But making was never monolithic. Makers have organized themselves in very different ways. Authors in this section shed light on the ways in which such implied universality is problematic if left unquestioned. People in different locations, in different social positions, and even within the same society hardly share the same privileges equally. This results in different desires and ideas of success, as well as different demands for information and survival in online and offline spaces.

Examples of how the needs and values of different communities in different contexts vary widely is addressed in relation to sex work under SESTA-FOSTA[14] (**Grace van Ness**), and as strategies for resisting state surveillance of online communication in China (**Kat Braybrooke**). Indeed, Chinese maker identity provides an access point for understanding the problems of discussing Global South making practices within a Western-centric discourse on critical making. For example, the maker practice of *Shanzai,* the production of cheap imitation goods, is deemed incompatible with the global digital economy, creating a tension between older local practices and the influx of borrowed digital universalisms and logics of the digital creative economy (**Xin Gu & Pip Shea**). In wealthy European and Australasian countries on the other hand, community workshops are being instrumentalized for creating attractive alternatives in terms of sustainable and liveable post-growth cities. Lastly, the domestication of maker-activists and counterculture community workshops and the negotiation of their ideals must be addressed in relation to local municipal support and evaluation (**Cindy Kohtala & Sharon Ede**).

This closing topic leads into questions around critical making practices and institutionalization. The apparent newness of the idea of collaborative knowledge creation in labs is countered by tracing its gendered and colonialist past. This lineage still informs how contemporary lab work is structured and valued in universities (**Maya Livio & Lori Emerson**), for example. On a more general level, instituting, as the process of being institutionalized, is discussed as an (im)possible arena for critical making practice (**Bernhard Garnicnig**).

14 The Stop Enabling Sex Traffickers Act (SESTA) and Allow States and Victims to Fight Online Sex Trafficking Act (FOSTA) are changes in U.S. sex trafficking law as of April 2018. SESTA-FOSTA makes it illegal to knowingly assist, facilitate, or support sex trafficking, and makes online services liable for the actions of their users.

Is writing about critical making like dancing about architecture?

Considerable effort has been made to include a variety of perspectives in this book. We are pleased to be able to present contributions from design, arts, engineering, media, and theory in all kinds of imaginable hybrids. Writings here come from people in academia, the creative industries, education, and activist collectives – or all of the above. However, as editors we are the first to admit that we have been decidedly less successful in including the voices from the Global South. That said, various authors discuss practices that do not originate in the Global North, and we encourage to follow such threads beyond the confines of this book. In different ways, everyone involved considers reading and writing to be meaningful enough to devote considerable energy to – to go through the time-consuming and emotional task of working through feedback given by two young strangers who continually ask for more. Perhaps being in such a position is related to having some kind of investment in the idea and potential of critical making in the first place. Perhaps what we consider to be *critical*, what we call *making*, is not even registered as such in other contexts, where communities have different methods and tools to give meaningful direction to what they do and create. As Donna Haraway reminds us: 'grammar is politics by other means'.[15]

Writing and making make an odd pair. With one hand, we formalize our societal reflections into the discursive power of words. With the other, we perform the concrete activity of making and creating. But without wanting to either underplay or overhype making, we believe there's enough to gain by reconnecting these two practices. We hope this collection of words can help articulate the criticality of making – forming the discursive in-between space that is so necessary for questioning making. We invite makers like ourselves – in classrooms, neighborhood communities, shared studios, tool shops, hackerspaces, and university labs – to inhabit this space. While this volume is inherently limited, we hope its contributions will offer you new ways of connecting with people, new approaches to tools and activities, and new methods for pushing the boundaries of your own practice. We want to thank everyone involved for their openness, persistence, suggestions, and wonderful enthusiasm. We hope you enjoy what we have made together.

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15 Donna Haraway, *Simians, Cyborgs, and Women: The Reinvention of Nature*, Free Association, 1991, p. 3.

Critical Making and Interdisciplinary Learning: Making as a Bridge between Art, Science, Engineering and Social Interventions

Matt Ratto
& Garnet Hertz

CRITICAL MAKING AND INTERDISCIPLINARY LEARNING: MAKING AS A BRIDGE BETWEEN ART, SCIENCE, ENGINEERING, AND SOCIAL INTERVENTIONS

MATT RATTO & GARNET HERTZ

Critical making is increasingly being adopted to describe design-oriented practices and pedagogies that include both conceptual and technical work[1]. Engaging with definitions and articulations of critical making is important given its increasing circulation. Critical making has found its way into workshops and papers, has been used as a theme for several academic conferences, has become the title for a number of academic courses,[2] and has served as a banner for a number of academic initiatives, including as a visioning principle for the Rhode Island School of Design.[3] It is therefore worthwhile to step back and describe Ratto's original intentions regarding the coining of this term and to articulate our ongoing research and pedagogical work to reincorporate both critical analysis and material making.

The term critical making was initially used by Ratto in 2009 to define a conjoined pedagogical and research practice that used material engagements with technologies to open up and extend critical social reflection.[4] These early experiences coordinating critical making workshops proved a fruitful source to explore theories about the relations between society and technology drawn from fields such as Science and Technology Studies and Philosophy of Science. Most importantly, this work served to articulate the desire 'to theoretically and pragmatically connect two modes of engagement with the world that are often held separate – critical thinking, typically understood as conceptually and linguistically based, and physical "making", goal-based material work'.[5]

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3 Rosanne Somerson & Mara Hermano (eds), *The Art of Critical Making: Rhode Island School of Design on Creative Practice*, Hoboken, NJ: John Wiley & Sons, 2013.

4 Matt Ratto and Stephen Hockema, 'Flwr Pwr: Tending the Walled Garden', in Annet Dekker and Annette Wolfsberger (eds) *Walled garden*, Amsterdam: Virtueel Platform, 2009. pp. 51-62.

5 Matt Ratto, 'Open Design and Critical Making', in Bas van Abel, Lucas Evers, Roel Klaassen and Peter Troxler (eds) *Open Design Now: Why Design Cannot Remain Exclusive*, Amsterdam: BIS Publishers, 2011, http://opendesignnow.org/index.php/article/critical-making-matt-ratto/.

The concept of critical making has many predecessors, all of which start with the assumption that built technological artifacts embody cultural values, and that technological development can be combined with cultural reflectivity to build provocative objects that encourage a re-evaluation of the role of technology in culture. Concepts coming out of the field of computer science include critical technical practice,[6] values in design,[7] reflective design[8] and adversarial design.[9] In the fields of art and design, similar concepts include critical design,[10] interrogative design,[11] speculative design,[12] para-functional design,[13] dissident design,[14] post-optimal design,[15] and critical engineering.[16] It is worth noting that the term critical making borrows from and builds on these concepts that bridge between critical practice and technological development. In fact, rather than seeing critical making as a distinct practice, we prefer to understand it as a general descriptor for kinds of conceptual-material work.

The term critical making highlighted the importance of the material in conceptual and analytic processes, a point that has been an increasingly dominant trope in social theories – the so-called 'material turn' that has been noted in a range of disciplines.[17] But perhaps more importantly, the focus on making was also intended to emphasize the value of material production itself as a site for critical reflection. As Ratto notes, shared experiences of making can 'provide joint resources for transforming the socio-technical imagination'.[18] Such an understanding is supported by constructionist pedagogical theories,[19] theory-based articulations regarding the 'push back' of the material world on processes of conceptualization[20] and, more

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6 Phil Agre, *Computation and Human Experience*, Cambridge: Cambridge University Press, 1997.

7 Helen Nissenbaum, 'Values in the Design of Computer Systems', *Computers in Society*, (March 1998), pp. 38-39.

8 Phoebe Sengers, Kirsten Boehner, Shay David, and Joseph 'Jofish' Kaye, 'Reflective Design' in *Proceedings of the 4th Decennial Conference on Critical Computing: Between Sense and Sensibility, (2005)*, pp. 49-58.

9 Carl DiSalvo, *Adversarial Design, Cambridge, MA:* MIT Press, 2012.

10 Anthony Dunne, *Hertzian Tales: Electronic Products, Aesthetic Experience and Critical Design*, London: Royal College of Art, 1999.

11 Krzysztof Wodiczko, *Critical Vehicles: Writings, Projects and Interviews*. Cambridge, MA: MIT Press, 1999.

12 Heather Martin and William Gaver, 'Beyond the Snapshot from Speculation to Prototypes in Audiophotography', in *DIS 2000 Proceedings of the 3rd Conference on Designing Interactive Systems: Processes, Practices, Methods and Techniques*, 2000, http://www.gold.ac.uk/media/25martin-gaver.aphoto.dis00.pdf.

13 Dunne, *Hertzian Tales*, pp. 43-68.

14 Craig Badke and Stuart Walker, 'Contextualizing Consumption', in Paul Rodgers, Libby Brodhurst and Duncan Hepburn (eds) *Crossing Design Boundaries*, London: Taylor & Francis, 2005, pp. 89-293.

15 Graham Powell, *Inside the Box (exhibition guide)*, Leamington, KY: Leamington Spa Art Gallery and Museum Royal Pump Rooms, 2005.

16 Julian Oliver, Gordan Savicic and Danja Vasiliev, 'The Critical Engineering Manifesto', *The Critical Engineering Working Group*, 2011, http://criticalengineering.org/.

17 Dan Hicks, 'The Material-Cultural Turn: Event and Effect', in Dan Hicks and Mary C. Beaudry (eds) *The Oxford Handbook of Material Culture Studies*, Oxford: Oxford University Press, 2010, pp. 25-98.

18 Ratto, 'Open Design and Critical Making', p. 253.

19 Seymour Papert and Idit Harel, 'Situating Constructionism', in *Constructionism*, New York: Ablex Publishing Corporation, 1991, pp. 193-206, http://www.papert.org/articles/SituatingConstructionism.html.

20 Bruno Latour, 'Why Has Critique Run Out of Steam? From Matters of Fact to Matters of Concern', *Critical Inquiry* 30 (2) (January 2004): pp. 225-248.

colloquially, by the experiences of the authors. Importantly, the transformation of one's understanding regarding the relations between society and technology may involve an affectual dimension that is often under addressed in both social and technical work: 'Ultimately, critical making is about turning the relationship between technology and society from a "matter of fact" into a "matter of concern". I [Ratto] see this as requiring personal investment, a "caring for" that is not typically part of either technical or social scholarly education'.[21]

The importance of integrative educational initiatives that work to bridge the humanities and technology is highlighted by the adoption of acronyms such as 'STEAM' by directors of mainstream educational initiatives. Here, the more traditional focus on Science, Technology, Engineering, and Math is supplemented with the term Art as a placeholder for the forms of knowledge and pedagogies associated with aesthetic and humanities-based education. Needless to say, it is no more possible to simply add in 'art' – whatever that term is expected to encompass – to pedagogical practices in engineering or science disciplines, than it is to simply add in 'engineering' or 'science' to art-based pedagogies. Some problems relate to institutional divides and the problems inherent in navigating between various organizations. Others relate to the variety of processes and results that are seen as valid forms of knowledge by differing disciplinary groups. Creating interdisciplinary approaches and perspectives that engage the epistemological differences between art and technology or science is not merely an additive process, but requires substantial and novel pedagogical moves.

The 'Critical' in Critical Making

We believe that 'critical' is an essential attribute for such interdisciplinary practice, including reflective thinking about the value propositions and epistemic boundaries and practices within traditional disciplines. We also see criticality as including expansive thinking about the site and social import of the objects and forms of knowledge that emerge from one's work. Second, we believe that productive project-based 'making' is an important mode of production for interdisciplinary work because it can operate as a non-disciplinary middle ground for different communities and groups. The linking of personal investment, critical theory, and material production is what marks critical making as a unique mode of engagement with the world. The authors, each in their own way, have continued these developments, looking to establish educational initiatives and curricula that work to develop critical makers with appropriate skill sets and understandings that engender critical innovations and experiments regarding the sociotechnical.

By 'critical', we tend to see this as following the interventionist and transformative theoretic work associated with the Frankfurt School of Critical Theory. The scholars most associated with the Frankfurt school included Herbert Marcuse, Theodor Adorno, and Max Horkheimer. These scholars – and many others – shared a conception of a 'critical theory' understood as adjacent from the dominant academic concept of 'theory' present in scientific work of that time. Rather than focusing on generalizable descriptions of current conditions, critical theory

21 Matt Ratto, 'Critical Making: Conceptual and Material Studies in Technology and Social Life', *The Information Society* 27, no. 4 (2011: p. 259.

was primarily concerned with understanding and constituting 'reasonable conditions of life'.[22] According to Horkheimer, doing so required a rejection of such normative valuations of theory as 'better, useful, appropriate, productive, and valuable',[23] due to the ways in which research associated with such valuations were both predicated by and worked to reinforce current social situations. Social transformation and an increase in 'human emancipation' required non-normative theory that strove to transform rather than describe. Here it is important to note the differences between 'critical' understood as merely reflexive and hermeneutic, and 'critical' as defined here and linked to the overt goal 'to liberate human beings from the circumstances that enslave them'.[24]

Certain academic disciplines such as political economy, philosophy, and cultural studies have promoted 'criticality' as an intrinsic aspect of their work and have actively developed pedagogical processes to help students adopt and practice critical approaches. However, we do not believe that criticality is an intrinsic aspect of any specific academic discipline. Instead, criticality can be understood as a present though often somewhat hidden aspect of all disciplinary practice. This is revealed by technical disciplinary engagements that have focused extensively on criticality as part of a technical practice.

Within the framework of technological design, criticality tends to first delete – or at least put aside – current value propositions associated with technology. Three critical material-conceptual practices can be singled out as illustrative of specific attention to the variety of naturalized values typically associated with technology and technological development. First, critical design as described and practiced by Dunne and Raby[25] addresses the dominant focus on commercialization and for-profit interests within the world of design, using the design and exhibition of objects to reveal these interests and provide alternatives. Their aim is to make consumers more aware of the values, ideologies, and behavioral norms inscribed in the designs that are used in their everyday lives.[26]

Second, critical technical practice[27] focuses on the value propositions embedded in specific technical disciplines and associated training, using engagements with critical literature from the humanities and social sciences as a way to trouble and contextualize the instrumental logics associated with computer science and engineering. Phil Agre's work is particularly meaningful for the development of critical making since his overt goal is the bridging of disciplinary mindsets that serves as a precondition to hybrid multi-disciplinary practices. Finally, Agre's concepts of critical technical practice have been extended into the field of design for human computer interaction under the term 'reflective design'.[28] Whereas critical technical practice

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22 Max Horkheimer, *Critical Theory: Selected Essays*. London, New York: Continuum, 1972, p. 199.
23 Horkheimer, Critical Theory, p. 199.
24 Max Horkheimer, *Critical Theory*, New York: Seabury Press, 1982, p. 244.
25 Anthony Dunne and Fiona Raby, *Design Noir: The Secret Life of Electronic Objects* Berlin: August/Birkhäuser, 2001.
26 Jeff Bardzell and Shaowen Bardzell, 'What is "Critical" about Critical Design?', Proceedings of ACM Conf. Human Factors in Computing Systems CHI'13 (Paris, France), 2013, pp. 3297-3306.
27 Agre, *Computation and Human Experience*.
28 Paul Dourish, Janet Finlay, Phoebe Sengers and Peter Wright, 'Reflective HCI: Towards a Critical

focused on encouraging and supporting reflection and overcoming of disciplinary divides, reflective design encourages the development of technical objects intended to encourage reflection on the part of users. In doing so, reflective design practitioners aim to denaturalize the passivity of the typical relations between technology consumers and producers.

What unites the above approaches is a focus on material-conceptual processes that bring together reflexivity and intervention. For each of the practices above, the process of being critical starts by denaturalizing standard assumptions, values, and norms in order to reflect on the position and role of specific technologies within society. However, in addition, a specific goal of each is to tactically intervene and disrupt traditional models of technological development by giving engineers, designers, and in some cases, the public, an opportunity to break out of the cycle of overworking, overproducing, and overconsuming – to step back and reflectively reconsider a broader spectrum of human experience and culture.[29] If technology is to improve society, it must be critically reflective and designed for the complexities of what it means to be human.

The 'Making' of Critical Making

As noted above, use of the term 'making' was initially intended to highlight the importance of material production and participation as key to critical thinking and conceptualization regarding technology. Equally, Hertz's position is that the term 'maker' is relevant to this work because in some ways it stands at the intersection of traditional media arts practice, product design, craft, and computer science research. Because of this, we find it useful as a model for interdisciplinary pedagogy: it is a materially-based mode of tactile practice that primarily sits outside of academic disciplines.

The term 'maker' took on a specific usage in 2005 when Dale Dougherty founded Make magazine, which he used as a term to rebrand and sanitize the term 'hacker' to be more acceptable to the public, schools, and potential sponsors. The term maker can be seen as a move toward craft-style practices and a distancing from the two definitions of what 'hacking' is: 1. breaking into security systems for malicious or criminal purposes (i.e. cracking), or 2. the clever subversion of making things work in unexpected ways (i.e. a clever hack). The concept of maker started out by highlighting ordinary people making in their garages and backyards, but eventually also enveloped work in the experimental media arts, open source hardware, and hackerspace culture.

Over the past fifteen years, the term 'making' has come to describe grassroots-oriented electronic hobby projects and initiatives that blend clever physical construction, craft, microcontrollers, robotics, and open source ideals based on the free sharing of information. As community-organized hackerspace studios, open source 3D printers, and DIY-style physical computing platforms have become more widespread, the concept of making has also grown considerably.

Technical Practice' in *CHI'04 Extended Abstracts on Human Factors in Computing Systems*, 2004, pp. 1727-28; Sengers et. al., 'Reflective Design'.

29 Phoebe Sengers, 'Phoebe Sengers - Research', Cornell University Faculty Website, https://www.cs.cornell.edu/people/sengers/index.php?page=Research.

However, the increasingly widespread adoption of the term 'maker' has not come without some costs. While we find the term 'making' useful as a method for democratizing the fabrication of technological objects, we also see that with this larger social adoption, the adversarial, political, and tactical components at the heart of many tech-oriented DIY practices have been largely removed and replaced with a singular interest in technological skill or craft. In other words, the popular concept of maker has unified an interest in a hands-on involvement in technology development, but has done so by subtracting critical engagement from the process. While some residual critical aspects remain, they have a milder resemblance to their ancestors, including a belief in open source accessibility of technologies and a belief that the tactile production of technological objects is important to human well-being.

Making has emerged as a powerful concept in unifying technological and social crafts, but we believe that the field needs to be more self-reflective and critical if it is to progress. Critical making raises questions such as: What are the relations between particular social agendas and technical objects and systems? How might sociotechnical systems be integrated with wider and more emancipatory values? What can we build to sustain and foster social equality and justice? What technologies are worth making? The definition of critical making contains the potential for its interdisciplinary mission: Making requires 'hard' skills of technology while criticality requires conceptual thinking. We see technical exercises of making an LED blink with an Arduino or 3D printing an object as fundamental first steps in education, but questions about the design, purpose, and cultural value of created things are important next steps in the process of making.

Critical Making in the Classroom

In this section we provide examples of our own research and teaching practices, demonstrating our commitments to developing critical makers – transdisciplinary individuals with the ability to link technical practices drawn from computer science and engineering-related disciplines and conceptual understandings and theories drawn from arts, humanities, and the social sciences.

Ratto's Teaching Experiences

I am an Associate Professor in the Faculty of Information, Bell University Labs Chair in Human-Computer Interaction, and direct the Critical Making Lab[30] at the University of Toronto. My work focuses on developing theories, practices, and pedagogies that increase understanding and human agency regarding the complex relationships between information technologies and society. For me, critical making is both a research object and the means for studying that object.

An important outcome of my work on critical making is academic writing aimed at increasing the uptake of material practices within traditionally language-based critical disciplines. The results of this work are often typical academic objects – journal articles, book chapters, edited

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30 http://criticalmaking.com.

collections, and monographs. I see this work as a necessary part of critical making given the predilection of higher education for abstract and linguistic artifacts. But these works are themselves built upon the traces of what I term 'critical making experiences', events that I and my students curate, where material production and conceptual insights and vocabularies are conjoined.

These events share the following characteristics: first, they are engendered by an ambiguity, contradiction, or disjuncture at work within one or more conceptual theories; second, they require participants to engage with the above conceptual uncertainties through a construction process that is more or less materially constrained; and third, though objects are produced through such processes, these objects are not the main outcome. Instead, the intended results of these experiences are personal, sometimes idiosyncratic transformations in a participant's understanding and investment regarding critical/conceptual issues. I have shared these experiences with a range of individuals in a range of contexts including private companies, public workshops, academic symposia and conferences, and, notably, within my own teaching. I have been teaching a class in critical making in the Master's of Information program at the University of Toronto since 2009. The class includes master and PhD students from the aforementioned program as well as students from engineering, architecture, and visual studies.

The critical making experiences that I have developed have addressed a variety of topics but for the most part have focused on issues associated with the increasing movement of digitally-influenced processes and value propositions into all aspects of the human social world. Depending on the year and current issues in the media, we discuss recent decisions regarding handgun legislation, developments around climate change, or issues about surveillance or privacy. I give students the specific prompt: 'Build a moral technology'. They have one week to design, build, and explain their project. In the following class, each group shows their results, describes how and in what ways it is a moral technology, and provides an overview of their process. These performances are followed by facilitated class discussions where issues, ambiguities, and outcomes are debated and described. These experiences are therefore motivated and supported by work from fields such as Science and Technology Studies and the Digital Humanities that highlights concerns related to digitality and information more generally. Scholars such as Donna Haraway, Leigh Star, Geoff Bowker, Bruno Latour, and many others have examined some of the dimensions of what we might generically term 'technoscience' and its emancipatory or constraining aspects.

Individual classes are organized as follows. Every class contains a conceptual exploration and making section. In the first few weeks of the class, the making section mainly provides some basic skilling around microcontrollers, electronics, and simple programming. Following the introductory weeks, we move towards more specific conceptual material explorations organized around a particular theme or question. Again, the class involves a set of specific readings around morality and technology, accompanied by a particular design prompt. Students build a response to the design prompt, show it, and discuss it with the rest of the class. Students are then tasked with writing a reflection paper in which they describe the project, talk about the process of building it, and link to course readings and readings from other contexts. The course ends with a final open show, a public exhibition of the traces of critical making.

The above pedagogical design has been remarkably successful in deepening student engagement and understanding of critical theories and sociotechnical issues. This is demonstrated in the sophistication of the written work done by students as well as the conversations carried out in class. Equally, in many cases, the objects that have been created have turned out to be quite evocative and interesting in their own right. However, I encourage the students to remain focused on the process of creation rather than on the results. Specifically, these objects are not typically exhibited or described outside of the course context. I believe the most important results of critical making should be critical makers – individuals with an enhanced ability to parse the complexity of our sociotechnical world.

Hertz's Teaching Experiences

I work as Canada Research Chair in Design and Media Art at Emily Carr University, where I regularly advise and teach graduate students. When initiating studio-based design projects with my students, I often encourage them to start out with the following methodology adapted from Sengers et al's[31] process of reflective design:

1. *Identify disciplinary metaphors and assumptions*: Identify core metaphors that guide and shape a discipline. For example, in the field of personal computing this could be 'desktop'. General assumptions of engineering include efficiency, reliability, convenience, and pervasive connectivity. Identifying metaphors can be the result of literature review, observation, or other research methods.
2. *Research metaphoric occlusions*: Carefully recognize and research what the metaphors and assumptions exclude, marginalize, or occlude. In the case of a computing desktop, embodied movement or position is marginalized. What disciplines, groups, or users are excluded by these metaphors?
3. *Invert occlusions*: Invert the core metaphor of the discipline by bringing the marginalized things to the center. Consider building a computer interface that uses the entire human body, for example. What would the new thing look like and how would it work? What if we designed only for occluded things?
4. *Build the inversion*: Physically build a new alternative that embodies the inversion. Low cost open source DIY tools, including digital design tools for physical fabrication, can accelerate this process. It is important to actually fabricate the thing because it has a tangible legibility, documents well, and has the potential to act as a meeting point or disruptor between different users and communities. Built things are 'real' and constructively propose how a system is envisioned differently.
5. *Deploy the object*: Disseminate the project through high quality video production, online documentation, and exhibition in a public setting. Depending on the project, qualitative data collection in the form of surveys, interviews, observations, or usability tests can be of substantial use in understanding the impact of the project, especially in measuring how it challenges and disrupts biases.

31 Sengers et al. 'Reflective Design'.

In addition to using this process of 'occluded' or 'inversive' design to help my graduate students, I use it as a method for my own studio work. I generally emphasize the made object more than Ratto does: I aim to build 'things to think with' that aim to be evocative things with their own form of agency. I see them operating somewhat like boundary objects[32] or boundary negotiating artifacts.[33] These devices – functional prototypes that are exhibited in public art galleries, documented online, and published as case studies in academic papers – work to expose the hidden assumptions and values embedded in technological systems. The purpose of these objects is to enable individuals to reflect on the personal and social impact of new technologies, and to provide a provocative, speculative, and rich vision of our technological future that avoids the clichés of consumer or industrial design.

Unpacking Hidden Assumptions and Values

The pedagogical explorations described above differ in a number of important regards, including the communities and disciplines in which the work is situated and, in a related way, the role and purposes of the final made objects. Hertz uses a five step process to build for occluded values, with the aim of building objects to provoke critical thought. Ratto uses tools and practices drawn from the maker community to directly engage with critical sociotechnical theory. However, both experiences share an emphasis on unpacking and opening up the hidden assumptions and values associated with modern sociotechnical life. Drawing upon work associated with domains such as critical design, critical technical practice, and reflexive design (among others), the critical making pedagogies of the authors make use of strategies familiar to art and design practice such as defamiliarization and aestheticization, leverage resources from the humanities and social sciences such as hermeneutic and metaphoric analysis, and engage with substantive tools and materials drawn from engineering and natural science fields. Critical making as a pedagogical strategy thus offers possibilities for truly engaged interdisciplinary work that directly confronts the difficult epistemological issues encountered when bridging disciplines. Finally, we want to note that the value of the term critical making is not that it replaces other descriptors of critical hybrid conceptual/material practice, but instead that it works to connect the diversity of tropes, themes, and disciplinary contexts from which such practices emerged. Refocusing our attention as artists, scientists, engineers, and scholars on the development of critical makers is an important step in the development of truly trans-disciplinary interventions into the sociotechnical world.

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32 Geoffrey C. Bowker and Susan Leigh Star, *Sorting Things Out: Classification and its Consequences*, Cambridge, MA: MIT Press, 1999.

33 Charlotte Lee, 'Between Chaos and Routine: Boundary Negotiating Artifacts in Collaboration', *ECSCW* 16 (3) (2005): pp. 387-406.

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Teaching Critical Technical Practice

Graham Harwood

TEACHING CRITICAL TECHNICAL PRACTICE

GRAHAM HARWOOD

> The science which compels the inanimate limbs of the machinery, by their construction, to act purposefully, as an automaton, does not exist in the worker's consciousness, but rather acts upon him through the machine as an alien power.
>
> – Karl Marx[1]

In 1958 the French philosopher Gilbert Simondon published *On the Mode of Technical Objects* to address just this form of cultural alienation implicit in the quote above. He writes, among other things, about two ways in which people come to know technical objects. He says when technology is viewed through the eyes of a child – which I imagine he is seeing as naive and innocent – we gain an implicit, non-reflective, habitual tendency. A baby strapped into a buggy is given a parent's mobile phone and is happily learning to play a game, but cannot yet utter the words to express these interactions. Simondon then imagines the inverse: a trained adult engineer, reflective and self-aware, who uses rational knowledge elaborated through science. Today, this might be an Apple engineer, someone who creates closed technologies and imagines that its users are still strapped in that buggy, unable to articulate their critical needs. Simondon seeks out another form of relationship with technical objects, locating it in the enlightened encyclopedism of Denis Diderot and Jean le Rond d'Alembert (from 1751-1777), in which concrete knowhow is abstracted and assembled into a technical orchestra.[2] Contemporarily, is it worth considering our networked technologies through this mode of encyclopedism – an evolving off-grid, redneck, student, coder, geek pedagogy producing technical information, hacks, how-to guides, shakedowns, and open source code repositories, that respond to an evolving technical culture? This technical republic is nothing new. Its genealogies can be traced back to the amateur experimentalists of the London Electrical Society and William Sturgeon (1783-1850) – and beyond. At the heart of this artisanal formation was a key concept: knowledge can be embedded in an object and its functioning is its explanation.

Is a tinkering internet a critical technical republic, a social space that potentially can break down state actors with encryption, corporations by opening up software, and proprietary technics by hacking them open, by making things public? Are the marginal technics in a teenager's dirty bedroom, the dank basement of a bored salaryman, or the ham radio garden shed strategies to unfold the clean room and its magic men in white coats? Or is this largely a white male space that has eradicated other forms of objectivity and subjectivity from view? How can we attempt to instantiate a devolved technics that refuses misogyny and racialization, envisaging an alternative outside the paradigms of human slave or potential human enslaver?

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1 Karl Marx, *Grundrisse: Foundations of the Critique of Political Economy*, London: Penguin Classics, 1993 (1939), p. 279.

2 Gilbert Simondon, *On the Mode and Existence of Technical Objects,* trans. Cecile Malaspina and John Rogove, Minneapolis: Univocal, 2017 (1958).

What follows is an introduction to the methods used in Critical Technical Practice informed by YoHa's (Graham Harwood, Matsuko Yokokoji) pedagogy, collaborations, and tinkering practice. YoHa's work involves the use of art as a mode of enquiry into technical objects. Most recently their investigations have been carried out within the fields of health, war, oceans, and death. The space of YoHa's inquiry is usually populated by an interconnection of technical objects and other kinds of bodies, as in a clinic, hospital, battlefield, or at sea. YoHa's focus of this enquiry is where the flows of power can be reconfigured by the uncertain meaning, or intention of art – not necessarily to make art but to make use of its ambiguity within a wider enquiry.

Critical Technical Practice

Even though there are many genealogies of Critical Technical Practice, a good place to start is Phil Agre's 1997 essay *Toward a Critical Technical Practice: Lessons Learned in Trying to Reform AI.* Here, Agre states that computers are not simply instrumental. Rather, the computer helps structure the site of practice as part of its very design. He constructs a sense in which computing can be seen as a form of imperialism, as 'it aims to reinvent virtually every other site of practice in its own image'.[3] Agre explores how his thinking was altered through learning computer science and subsequently reading critical texts across disciplines. Agre goes on to explain how he uses his intrapersonal experience to explore the role of criticality within the field of AI while looking backward and forward in the field. Agre charts how his intrapersonal space – his 'consciousness and purpose' changed – describing it as 'a slow, painful, institutionally located, and historically specific process'.[4]

From Agre's thought, a number of threads emerge: technologies are positioned as politically, culturally, socially, and economically affective; the intrapersonal space of people involved in a project is a legitimate site of enquiry; and each project is associated with an evolving pedagogy situated in an evolving environment. The complexity of our interrelations with technical objects preconditions the humility with which we approach a subject/object.

Ethics (or their lack) are interrelated with personal and professional risk, creating useful checks and balances. Ethics become the context for what is made visible and what should remain invisible to forms of power. For example, if you are working with a group of people investigating how they get round/avoid/misinform certain formations of governance, it would be ethically wrong to then go on to report this to management. Ethical conflict and risk – whether personal or project-based – are important motors of engagement with technical objects, institutional, social, or discursive critique. They help chart the historical conditions of the path the project has taken.

A related fork of Critical Technical Practice coincidentally aligns with many of these threads. Initiated at the former Centre for Cultural Studies between 2007-2017 at Goldsmiths, University of London, it was a way to examine the live techno-social aspects of contemporary digital

3 Phil Agre, 'Toward a Critical Technical Practice: Lessons Learned in Trying to Reform AI' in Geoffrey Bowker, Susan Leigh Star, William Turner and Les Gasser (eds) *Social Science, Technical Systems and Cooperative Work: Beyond the Great Divide,* Hillsdale: Erlbaum, 1997, p. 26.

4 Agre, 'Toward a Critical Technical Practice', p. 16.

culture. This stream of Critical Technical Practice (CTP) also incorporated art methods in a relatively close alignment with threads pulled from Agre above. At its broadest, the CTP taught at Goldsmiths can be summarized as the formation of thought and action that incorporates art as a method of enquiry into particular sociotechnical milieu. This is a compacted intellectual form, that makes the space between the technical, theory, practice, and the intrapersonal ambiguous. A typical class in CTP would make/explore things, attempting to explain the phenomena caught in the lens of a project or a proposition, ultimately reflecting on the process. The methods first arose in Cultural Studies from the need to figure software as a technical, cultural, and interpersonal object.

A simple problematic could be:

In the Technical domain: if the exact same web browser runs on a series of machines but has different software dependencies, operating systems, and the like, is it the same software given that its functionality changes across different platforms?

In the Social/Cultural domain: if that series of machines happens to run in different enterprises, cultures, societies, political, and economic regimes, how can we think about the ways software is affective in these different registers?

In the Intrapersonal domain: How has the browser affected memory, language, learning, and sociality?

What boundaries/frames of possibility are created when software exists between the three overlapping domains? The simple example above points to some of the complexity in asking questions of technical ensembles.

In Critical Technical Practice we normally make no absolute distinction between the domains of the technical, social/political, cultural, or intrapersonal. A live machine under enquiry will be plugged into action, reaction, enablement and disablement with all of the domains simultaneously. The domains themselves are arbitrary distinctions imposed or imagined to make thinking easier or to express ourselves within forms of well established thought and action. The domains are not a good fit – but they are all we have.

As an example of how such complexity can be addressed, we might propose that the class create a simple Denial Of Service (DoS) attack on a remote test server by learning to code computers for the first time. It is empowering for students to find out how quickly they can code. The class would learn how to do this from T.J. Connor's book *Violent Python*.[5] After the group had reached a self-satisfied tingle of radicalism, the group would be asked to look up the author and would find that Connor is a top grade US Military expert. The group would then look at the book's distribution and market penetration and be encouraged to question the affective logics, politics, and culture of the book. They would then reflect on

5 T.J. O'Connor, *Violent Python: a Cookbook for Hackers, Forensic Analysts, Penetration Testers and Security Engineers*, Amsterdam/Boston: Syngress, 2013.

why the workshop had been constructed the way it was and how their own learning in different registers of technicality, politics of information, personal critique, and empowerment was achieved. Critical Technical Practice, then, is not necessarily a reduction of phenomena to literature or a system of logics, but can instead be thought of as knowledge incorporated into a thing that the class created, looked at or pointed to, through revealing a certain type of gaze.

Foucault describes the formative relationship between seeing in its widest sense and knowing in *The Birth of the Clinic*. He asserts that the 'bright, distant, open naivety of the gaze'[6] is transformed by the 17th century birth of discourses of empirical observation: a machine that sees itself detached from its subject is able to make objective observations about it and use the results to reason. This form of gaze is incorporated into many discourses, from the technical and scientific to the historically artistic. The gaze, and how language changes to interpret that gaze, is the means by which Foucault charts the Birth of the Clinic. According to Foucault, we can think about the simple and naive act of looking as having agency. This particular form of silent perception allows for the author of the gaze (and in this case the class) to attentively listen to the observation. The observation then requires expression through language and gesture in order for the observed to become visible within culture and shared in society. This expression is usually transformed by the class into a complex problematizing object or action.

A prerequisite of Critical Technical Practice is that it incorporates this form of gaze in thinking through the formation of oneself as a thinker and actor in the world. Enquiring into one's own pre-existence helps understand the structuring of potential that has informed what one has become, what one could easily recognize, and what one could easily achieve. As we have seen with Agre, this informs one's intrapersonal experience of a project. This is not a summation of limit but an acknowledgement of the hard work needed to escape a pre-existence, as it may relate to pillars of repression or suppression, class, gender, sexuality, and race. The situated knowledge of family and friends, their relation to making things, to popular culture, to oral histories, to struggles with money or law, reading, writing and speaking – all these factors inform this process.

To this end, CTP is partially related to a schizoanalysis of Foucault's question: 'What are we today?'.[7] The class is always encouraged to unfold this question: Which conditions constrain, control, resist, govern, and determine this moment and not another? What patterns of recognition are we privileging and why does it blind us to others? How does language restrict us at the very moment we are able to say something? How can this engagement be born anew at every instance of examination?

6 Michel Foucault, *The Birth of the Clinic: an Archaeology of Medical Perception,* trans. Alan Sheridan, London: Routledge, 2003 (1963), p. 65.

7 Michel Foucault, *Technologies of the Self: a Seminar with Michel Foucault.* London: Tavistock, 1988, p. 145.

Media at the Margins

'[N]either mass media nor social media exhaust the ambit of media, any more than historically specific technologies and practices give us the standard by which to define and hence to understand processes and practices of mediation'.[8]

As a second clarifying example of pedagogy and CTP, we can appropriate Matthew Fuller and Andy Goffey's book *Evil Media* for use in class. The term 'grey media' coined in the book has become a placeholder for forms of machines that alter the conduct/governance of those individuals – both technical and biological – that are part of their structural operations. This can be thought of as those parts that make up a Simondon-type technical ensemble, where individuals interrelate to form an emergent technical collaboration with human agency.

Students in this class are encouraged to find an evil/grey media object and present to the class, concentrating on how its materiality is part of the world in which it also participates. This could be anything from a Post-it Note, to an antidepressant drug, the corner of a shipping container, a software object, or any other form or media object that is not usually given critical scrutiny. One grey media machine that illustrates the theme of the work would be *Form Validation Rules,* here commented on by Felix Drăgan, a former student at Goldsmiths.

> Validation rules are syntactic and semantic criteria applied to the data in form fields. These rules are used to police data input, to ensure its uniformity and compliance with underlying database formats and constraints. In the case of electronic forms, the automated validation subroutines are also designed as a defense mechanism against accidental or malicious user action. These circumventions or failures in code execution have the potential of revealing otherwise hidden attributes of encoded data with its relational structure, embedded assertions, or judgements.[9]

Another example is the *Pedestrian Barrier* authored by the artist Simon Pope on a Pedestrian Barrier produced by the company Qingdao Yongchang Suye Co., Ltd.

> The Pedestrian Barrier, like other portable security fences, is used for general crowd control and demarcation and can be finished in several ways: painted and hot dipped, galvanized, or hot galvanized only. It has a fixed leg that can be delivered to site and assembled without any additional fastenings, and arguably typifies the 'solid mid-sized objects' that philosopher Ray Brassier sees as defined by our common sense understanding of the world. Once deployed, it produces both isolation and kinship in other objects, depending on which side of the barrier those objects lie. Its manufacturers also provide an OEM service.[10]

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8 Matthew Fuller and Andrew Goffey, *Evil Media,* Cambridge, MA: MIT Press, 2012, p. 12.

9 Excerpt from Felix Drăgan's contribution to the project *Evil Media Distribution Centre*, shown at Transmediale 2013, which consisted of an exhibition involving 50 international artists, 8 of which were ex-students. Open systems Association, Anna Blume, and Tom Keene are former students at the Center for Cultural Studies, and Tom is a current Design Star PhD candidate, http://yoha.co.uk/node/666.

10 Excerpt from Simon Pope's contribution to the project *Evil Media Distribution Centre*, http://yoha.co.uk/node/689.

This formulation of grey media is explored in class by proposing that technical objects have a directive side or could be considered desiring in philosophical terms. This can be thought of more widely as how do we create a critical understanding of media interaction and the formation or performance of power. The ability to manipulate the directive side of technical objects through multiple scales of logics can be one place where the kind of evil described in Fuller and Goffey's book resides.

This class explores how the directive side of technical objects can be thought through with the design/individuation of the technical element and individuals, ensembles in a simplified Simondonian sense. The space of a desiring technical individual is unfolded as it (among other things) encourages us to alter our minds, behaviors, and bodies in order to better use them. Our self-modification in response is often rewarded by allowing us to more clearly tune in to technical objects and receive cleaner channels of information from them. The programming and use of computers, for instance, implies both programming the machine in order to perform calculations and regulating the conduct of users in manipulating mice and menu systems, ordering their input to produce desired results.

The class as a whole is then encouraged to explore how people participate in the flows of power, language, and logics created in collaboration with technical objects. They investigate how the processes of these objects become normalized, and how we become entangled in their interrelations across various scales. As we once again become unfamiliar with how software operates within computation and culture more generally, it makes sense for the class to enquire into how such logics operate in other realms: social processes, politics, economy, and the intrapersonal sphere.

Risk, Ethics and Critical Acts

The critical in Critical Technical Practice has its own genealogies, discourse, and armies of academics hurling papers at each other over multifaceted barricades. While I'm happy to raid this battlefield from time time and remix the devastation or causation for a class, I'm certainly not intellectually or educationally equipped or sufficiently interested to reveal the intricacies of such a mire in here. I leave this to my stunning colleagues, Prof. Matthew Fuller and Dr. Luciana Parisi, who consistently feed the students' hungry appetite in this area. However, adjacent to discursive threads of criticality, there are other forms that can be easily be transposed and digested in a practice-based class. There are critical acts that surface from the struggle to survive and flourish in an unfair world. There are critical acts created by tactical media, by the deranged, or those taken from the fringes of art. Thinking with such critical acts, as discussed in the introduction, allows us to address the personal risk and ethics (or lack thereof) associated with them.

These forms of critical acts are multivalent in wider culture and it becomes important to both value and interrogate the nature of such phenomena if we are to incorporate them into Critical Technical Practice alongside intellectual critical threads. Students need to consider what might constitute a critical act at the microscopic and macroscopic scale, and to chart how it functions as a disruptor/constructor/enabler/disabler within culture and society. At the same time, students need to discriminate between considered and unconsidered critical acts, their ethics and the worth of personal or institutional risk.

One less considered example of a critical act that I came upon this year in my hometown was that of Snakey, a paranoid 34-year-old who lives on an old 16 ft plastic boat. Snakey's boat had been abandoned on the mud for 10 years with no facilities of any kind, no means of propulsion. One night he just pulled it out of the Thames marsh and up on the mud alongside the locale cockle sheds, where his estranged dad and brother run a successful seafood business. Snakey eats and throws the rubbish out of his boat and urinates in used plastic drink bottles, throwing them overboard when the tide is out. Snakey demonstrates his contempt for those who know him and those who know he has committed something considered disgusting. People are forced to witness his light yellow urine contained in plastic bottles, a stand in for his contempt for the environment. He could have urinated straight in the sea like all the other men, but decided to dirty his nest, to contain his bodily wastes for others to witness. In this way Snakey spontaneously produces a critical act in a bottle that fractures the complacency of those that share this common space. It is a powerful act, a declaration of bodily power that resists, exposes, and exploits the preconditions that have created his current situation. It also creates an unbearable embarrassment for his dad and brother.

The critical act of Snakey fractures complacency by introducing turbulence into cultural and social 'common sense'. The unthinking equilibrium amongst people of the shoreline that blinds society is temporarily broken. The energy/discord produced pulls into focus what conditions the moment – not necessarily for Snakey but those that exist within the relations surrounding his acts. The multivariate nature of critical acts and their interdependence with cultural and social norms makes them a compelling subject of study, but not necessarily a model to follow.

Searching for someone else who fractures complacency, but who does it within a pedagogy more closely related to the needs of Critical Technical Practice, I turn to the offerings of Mark Fisher. Mark, formerly of Goldsmiths, was a working class intellectual of Felixstowe, a port town on the East Coast of England. Mark, who sadly committed suicide earlier this year, was able to think through contemporary culture and mental illness in order to illuminate contemporary capitalism. His book *Capitalist Realism*[11] drips with a politicized depression and bears witness to the annihilation of vitality both in the depressed self and wider society in the early 21st century. Fisher's politically depressed vision is not surprising given that his lens was grounded by the exhilaration of people making culture for themselves without it first being apprehended by large corporations and turned into free labour before you have even had a chance to think about it. Or maybe his lens was tinted slightly pink, a nostalgic hue stemming from his solidarity with the 1984/85 miners in the UK. This was the last time there was class-based political power outside of an elected dictatorship, a power which arguably has now been supplanted by Facebook and other social media.

Mark Fisher's book offers the class a critical realization of our own macroscopic entrapment within a totalized capitalist imaginary, much like Snakey's piss bottle challenges the pre/conditions of poverty and mental health at the microscopic level. Just as a critical act unfolds Snakey's piss bottle into the relations that make it real, Mark Fisher's question – is there no alternative to Capitalist Realism? – requires us to question Capitalist Realism as a rubric of reproduction that keeps

11 Mark Fisher, *Capitalist Realism: Is There No Alternative?* Winchester: Zero Books, 2009.

us mesmerized by a desiring consumption. It also begs the question that he usefully does not present: how do we figure the way Capitalist Realism performs itself through technical objects? This question allows the class to ask another: is Capitalist Realism the only thing performed through such technical individuals? Mark effectively lays out a concise mapping and a challenge – a landscape of desire, production, and consumption which in popular terms, technical critical practice can affirmatively engage with.

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The Counter-Testimony of the Maker

Maria Dada

THE COUNTER-TESTIMONY OF THE MAKER

MARIA DADA

This chapter begins with the question of critique. How and why do we critique – but more importantly, why does no one critique effectively anymore? This sentiment is echoed by Bruno Latour in the paper *Why has Critique Run out of Steam?* He states: 'It does not seem to me that we have been as quick, in academia, to prepare ourselves for new threats, new dangers, new tasks, new targets. Are we not like those mechanical toys that endlessly make the same gesture when everything else has changed around them?'[1] According to Latour, the absence of principles is to blame. As he puts it, critique has battered through all claims to a ground, eroding any sense of a solid foundation, and with it, a compelling argument. The result is that there isn't even a sure ground for criticism. Without a ground, it's hard to differentiate a rigorous critical claim from a conspiracy theory. That's why conspiracy theory books are best sellers. Latour mourns the death of critique. In its tattered remains, a whole industry has sprung up, denying that the Apollo program ever took place.

Critique is a method and a mode of self-reflexive questioning which comes out of the age of Enlightenment, an era which for the most part was comprised of thinkers that held reason and reasoning in high regard. The purpose of critique was to question our understanding of reason in order to keep it in check. Critique's task was to unleash our understanding from the shackles of any particular dogmatic defining view. Whether we argue that the Enlightenment has overinflated the power of reason (as counter-Enlightenment voices would suggest), or narrowed it, the point is still the same: reason is misrepresented under Enlightenment principles and critique is there to rescue it. My claim is that the absence of principles transforms critique into an issue around the strength of evidence and the credibility of the testimony. Effective critique is synonymous with the counter-testimony of a reliable witness.

A witness is someone who is present at the time of an event, often a crime, and is able to testify before the law. They are able to give direct evidence in relation to the events. However, they often rely on foggy memories and blurred vision. It is not too difficult for the defense or prosecution to put the reliability or credibility of the witness in doubt. Here is where the role of making comes into play. More often than not, in the post-critical age, a testimony or counter-testimony is not simply uttered, but is rather constructed. Latour is the first to admit that a critique has to be made. As such, the eyewitness is no longer a person but a photograph, a video, or other forms of surveillance. Juries are more decisive when they are presented with the facts – the evidence submitted as an object as opposed to the fuzzy testimony of a witness. Critique, or counter-testimony, is a material process enabled by infrastructure. It is a practice-based question of physics, chemistry, and the material forms of agency.

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1 Bruno Latour, 'Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern', *Critical Inquiry* 30, no. 2 (2004): p. 225.

Given all this, I will further explore the role of critical making as counter-testimony. From the aesthetic practices of forensics and counter-forensics to the role of labs in media archaeology and investigative practices, I will tell the story of makers that present their objects as a counter-narrative to pressing sociopolitical issues. More importantly, however, I will address the issue of how critical making practices can establish credibility in a world of fakes and a general loss of belief.

The Problem of Critique

Heather Dewey-Hagborg's *Stranger Visions* appears as a collection of 3D-printed, life size, full color 'portraits' which are computationally generated from traces of DNA extracted from the hair, chewed gum, and cigarette butts left behind by everyday New York City pedestrians. Each exquisitely constructed 'portrait' depicts what a single stranger might look like, a representation based on their genetic profile. The project calls attention to increasingly sophisticated biological surveillance mechanisms. The work can be framed as the creation of a critical maker, someone who gathers or produces objects, artifacts, words, and images as critique. But what's the difference between an object of critique, the 3D-printed sculptures, and all the other objects proliferating on the internet or in galleries that – by and large – are sophisticated in their own right? What is critique in this context?

The issue that greatly affects the practice of critical making is that, at the moment, there is no unified view on what a critical maker might regard as reason because Enlightenment critique, through its incessant questioning, has dismantled most ideas around or grounds for reason. It is unclear what form of reason is still held in high regard – if at all. Under such conditions critique finds itself in trouble. You see, critique and reason go hand in hand; one acts as the means of establishing the other. Without critique, one cannot reason with care; without reason, one has no base from which to critique. If critique is in trouble, so too are critical makers. More than this, with the crisis of uncertainty, hesitation and increasing skepticism, the disappearance of critique becomes dangerous, impinging on our ability to effectively respond to climate change and other global issues: political stalemates, international aid, immigration – the list could go on and on.

However, it is climate change that troubles the two theorists that I will discuss here. Both Bruno Latour and media theorist Wendy Chun consider the loss of faith in science in the face of climate troubles to be highly significant, and the primary reason to resurrect critique. I will start with Latour. Latour believes that critical theorists have spent far too long refusing to engage with what he calls *matters of fact*,[2] what scientists would call *brut fact* or empirical facts. As he states in an article from the 2004 *Critical Inquirer*, the mistake is to think that the only way to critique *matters of fact* is to move away from them.[3]

As a result, these critical theorists never experience a complicated object, such as those found in science and technology. Michael Serre, although far from critique, is one of the few thinkers that takes the objects of science seriously, in an ontological and anthropological fashion.

2 Bruno Latour, 'Why Has Critique Run out of Steam?', p. 231.
3 Bruno Latour, 'Why Has Critique Run out of Steam?', p. 231.

Other theorists and philosophers, however, seem to drink a lot of coffee and therefore the only objects they seem to experience are jugs – an object that was philosopher Martin Heidegger's favorite object to reflect upon. Sometimes, in order to diversify their descriptions, they employ rocks. But wouldn't it be more interesting, according to Latour, if instead of a rock they described dolomite?

Because critical theorists don't muse upon sophisticated objects, they cannot see them as what Latour calls *matters of concern*, something more akin to works of art or works of social and historical significance. For instance, philosophers such as Martin Heidegger would consider a handmade jug to be a *matter of concern,* but a can of Coke made in a factory is only an object, a *matter of fact*. *Matters of concern* are those endowed with political meaning or aesthetic significance.

Unlike Heidegger, Latour believes that rich technical objects can be transformed into *matters of concern*. He cites the Challenger disaster of the 1980s – the shuttle orbiter that broke apart seconds after attempting flight – as a perfect example of such a transformation, one that occurred in just 73 seconds. Conversely, *matters of concern* can also be transformed into objects or *matters of fact*. Consequently, Latour's method of critique entails transforming *matters of fact* into *matters of concern*. Isn't that exactly the task of the critical maker: to take objects of fact and transform them into objects of concern? While that may be the case, the task is not so simple. 'You can do one sort of thing with mugs, jugs, rocks, swans, cats, mats, but not with Einstein's Patent Bureau electric coordination of clocks in Bern', argues Latour, 'Things that gather cannot be thrown at you like objects'.[4] When we transform objects into *matters of concern,* we weaken their claim to science. *Matters of fact* are thrown into doubt when they merge into highly complex historically situated *matters of concern*.

Why? Here Latour blames the methods of the social sciences and humanities. *Matters of fact* are always portrayed in a ridiculous way in the social sciences (and we could add critical making here), where critique has come to resemble a form of anti-fetishism, or the 'fairy position', as Latour puts it. The fairy position refers to common arguments in the social sciences that reveal the desires and wishes – the 'fairies' – falsely cast onto objects. The social scientist or maker critic always shows the naive readers, as believers, that they are falsely projecting their wishes and fetishes onto a material entity, the object. In other words, the critical maker is attempting to reveal the ideologies and hegemonies that are projected onto the entity. 'Look naive reader/viewer/idiot', the critic says, 'the forces that you are not conscious of are acting on you'. But no one outside of the discipline is interested in what social scientists do to *matters of fact*. No one cares about the societal rug being snatched our from under their fetishized objects. No one wants these objects to be treated this way. Readers would rather stick to *matters of fact*. More than this, such a form of critique is useless when it comes to objects of some solidity. The projection game cannot be played on neurotransmitters, for instance. The task is not to pull the rug from underneath *matters of fact* and reveal their conditions. Such a move diverts the attention away from *matters of fact* onto what makes them possible or impossible, a move that in Latour's view has been overdone. Nonetheless, critique is also

4 Bruno Latour, 'Why Has Critique Run out of Steam?', p. 237.

useless when it uses the results of science or *matters of fact* uncritically. Although Latour somewhat condemns the fairy position, he is not advocating for its opposite, what he calls the 'fact position' and what in the social sciences might be referred to as positivism. In sum, fetishes don't work because we all have fetishes, and *matters of concern* don't work because we've seen that they are fetishes.

Latour concludes that a new method has to be devised, one that does more than show that objects are simply non-conscious societal projections of readers. Latour claims to be searching for something along the lines of Andrew Pickering's *mangle of practice:*

> Not a flight into the conditions of possibility of a given matter of fact, not the addition of something more human than the inhuman matters of fact would have missed, but, rather a multifarious inquiry launched with the tools of anthropology, philosophy, metaphysics, history, sociology to detect *how many participants* are gathered in a *thing* to make it exist and to maintain its existence.[5]

Acting under Uncertain Conditions

For Wendy Chun, the issue is not that critical theorists no longer engage in *matters of fact*.[6] It is that we, as a form of information-seeking public, have come to expect an unreasonable amount of certainty from our *matters of fact*, an amount of certainty that was not demanded of the thinkers of the Enlightenment, an era when scientific doubt was welcome and formed a huge part of the scientific process.[7] According to Chun, we are in a 'CSI effect' era where there are impossible expectations placed on science. *CSI*, or *Crime Scene Investigation*, is one of the most watched television series in the world. In every episode, the CSI team manage to close the gap between speculation and conviction by finding forensic evidence, DNA samples, and fingerprints – all of which come together to irrefutably point the finger at a criminal. For Chun, CSI investigations play out, mimic, or prefigure the thought process that demands the closing of the gap between scientific evidence and scientific results. All the evidence must point to the answer, beyond the shadow of a doubt. Systems of truth and justice play out in the court of public opinion.

The unreasonable demand placed on reason and its *matters of fact* is a result of Enlightenment era critique and skepticism. It is because critique continues to batter the uncertain grounds of reason that certainty becomes necessary. The request for certainty erases the fact that debate and dispute are central to science. The selling of science as 'true' shuts down debate. As a result, *matters of fact* have been disarmed. Initially devised to support science, the tools of the Enlightenment are now being used against it. Consequently, climate change has been predicted, but little has been done. For Chun, it's not a question of enriching our

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5 Bruno Latour, 'Why Has Critique Run out of Steam?', p. 246.

6 Wendy Hui Kyong Chun, 'On Hypo-Real Models or Global Climate Change: A Challenge for the Humanities', *Critical Inquiry* 41, no. 3 (2015): p. 3.

7 Wendy Hui Kyong Chun, 'On Hypo-Real Models', p. 5.

matters of fact. The facts are known. The issue, then, is not about attaining more certainty on climate change issues. The earth's temperature has been increasing since the 1950s, and the facts are all there. The issue is that we seem to have lost the ability to act within uncertain conditions. We constantly expect reason to hand us certitude, to deliver up incontestable certainty. Given these high expectations, conservative organizations and rogue scientists have no problem injecting doubt into any issue. The debate can then be easily portrayed as science versus politics. But that is not a productive ground from which to structure the debate. In this murky fog of skepticism, critical makers, armed with critique, do nothing but amplify the voices of the deniers, and the merchants of doubt become the scientists themselves.

For Chun, uncertainty needs to be enabling. Uncertainty is necessary in order for us to engage in risk that cannot be seen or experienced. We need to make do without the notion that uncertainty fosters inaction. If the public think that all the *matters of fact* need be gathered in order to achieve certainty, that such a feat is even possible, they will try to do so – and be paralyzed, frozen in inaction until they achieve this certainty. However, we have to be careful not to reduce complexity to an incident that is easily solved or determined. Rather than adopt the forensic logic of verification – a process that accrues evidence in demand for accuracy and certainty – we need to work with hypothesis, a process that 'makes do' with suppositions that prompt further action and investigation.

Extralegal Strategies and The Entanglement of Law and Norm

For both Latour and Chun, to act within the realm of reason is effectively to act within the realm of scientific reason and *matters of fact*. It is the science of the Enlightenment that they are both attempting to save from the clutches of uncertainty and conspiracy theory. For them, science is that which single-handedly put an end to the authority of religion. In that sense, it *is* the Enlightenment, and it is in trouble. But one thing that Latour and Chun seem to miss is that science is not the only arena from which we can act with reason. Certainly *matters of fact* are important, but these facts lack political meaning without any recourse to the norms and values in which they operate. The philosopher Immanuel Kant, one of the fathers of critique, was also one of the first to realize the important relationship between reason, science, and what might be referred to as *matters of the law* – that it is the laws of reason that are the arbiters of empirical *matters of fact*, whether they be natural, moral, or juridical.[8] When elaborating on the importance of being able to act within the bounds of uncertainty, Chun leans on the work of theorist Ulrich Beck. However, what she misses in her reading of Beck's *World Risk Society* is that the limitation of the demand for certainty does not occur only within the realm of science, but also within the bounds of the law. It is both science and the law that fail to respond to catastrophes such as climate change.

Science has always gone hand in hand with Enlightenment ideas, including critique. However, the notion of law, especially the natural law, was also pivotal. Much of the work of critique was around releasing reason from the bounds of its laws, not only the natural ones but also the

8 Immanuel Kant, *Critique of Pure Reason,* trans. Paul Guyer, Cambridge: Cambridge University Press, 2009, p. 109.

moral and the juridical. Michel Foucault, for instance, traces the genealogy of 'governmental' reason, beginning from the reason of governance and lawmaking such as the execution and torture of criminals, through to the historical shift from natural laws set by the church to those set by science, and finally on to the laws of price and demand of the market.[9] Whatever the method of critique may be, it is meaningless if it doesn't speak to and against norms, values, and political leanings.

The term 'conspiracy theory' from which Latour is protecting science is a legal category in itself. It is the law that determines what is conspiracy theory and what is not. As such, the difference between a critique and a conspiracy can only be made before the law. Bearing this in mind, there is something about the verification processes of the *CSI* mindset to which we must pay closer attention: the placement of evidence before the law. In certain legal systems, *matters of fact* are questions that are answerable through the collation and construction of evidence, as well as the inferences that such evidence allows. *Matters of the law*, on the other hand, are those questions which can only be answered through recourse to the law, through its application.

The issue is – and here is where the *CSI* mindset falls short – laws in our current era are continuously suspended, placed under exception. Today, as Louise Amoore contends in her article 'Risk before Justice', the instruments of governance, 'take on the shape of diverse tactics rather than laws'.[10] All juridical decisions are replaced with risk strategies that are implemented as exceptions to the law. Amoore gives the example of the memoranda for granting a US visa waiver to European citizens. Such memoranda are an indicative example of the suspension of, and exception to, the law. The law states that all European citizens are granted a visa waiver when entering the US. However, various memoranda – most notably the one made famous under the Trump administration – place this law under an exception that evaluates the potential risk that the passport holder poses to the US, statistically calculated in relation to their place of birth. The text of the agreement outlines the extralegal practices implemented, whereby individuals are screened and risk scored before travel. The law is no longer able to grant a visa waiver definitively, but rather relies on risk management strategies and extralegal practices. The danger of these practices is that, unlike the law, they are not limited in their application or measured against a certain notion of justice. For instance, the racial profiling of Muslim people on the London Underground would be prohibited under law, but is made possible through these extralegal maneuvers. According to Amoore, it is these extralegal practices and their relationship to the law that define norms. As a result, our understanding of the difference between law and norm becomes complicated.

Each of these risk practices 'defer sovereign decision'.[11] Many legal activists are increasingly inclined to reinstate laws, like human rights, against these exceptions. However, such actions are futile when the law becomes so intertwined with its exception. Legal institutions and

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9 Michel Foucault, *The Birth of Biopolitics Lectures at the College De France, 1978-1979*, trans. Michel Senellart, Basingstoke: Palgrave Macmillan, 2011.

10 Louise Amoore, 'Risk before Justice: When the Law Contests Its Own Suspension', *Leiden Journal of International Law* 21, no. 04 (2008): p. 847.

11 Louise Amoore, 'Risk before Justice', p. 849.

judges have been replaced by risk management experts and mathematical models. Here, a conversation with the law on the grounds of justice or rights becomes nearly impossible. These so-called 'experts' act as witnesses that present evidence before the fact, evidence that is meant to deny the fact its existence, to prevent it from happening. Under these circumstances the threshold of what is permitted as evidence changes.

Testimony of the Maker

For evidence to be effective against these extralegal measures, they have to exist within its threshold as evidence before the fact, or what we might call counter-risk or counter-speculative evidence. The role of the critical maker under such a regime is to construct the *matters of fact* as evidence that undermines the risk expert, countering the possible risks of financial, military, border, and terrorism activities. They have to become an 'expert' under a different administration of rights. Nonetheless, *matters of fact* have to be produced, put forth, related extra-juridically to uncertain conditions, evidently and aesthetically. This is not a case of revealing the hidden fetishes of facts in order to dismiss them. It is reveling in counter-facts in order to dismantle the norm. It is making certain that the world remains uncertain – despite its continuous capacity to calculate a certain type of risk.

Latour is right in claiming that: 'The critic is not the one who debunks, but the one who assembles'.[12] Evidence constructed against the extralegal is dolomite, a far richer and more nuanced way of describing the translucent mineral. This is not the generic jug or the banal rock. And it is at precisely this moment that *matters of fact* become *matters of concern*. It is that which is made to sit in front of risk management techniques as that which is not compatible with it, that which aims to change it. It is not the production of evidence in order to maintain the authority of the law, but in order to reveal its impotence and undermine its reliance on 'experts'. In such a scenario, the critical maker becomes a statistician, not in the predictive financial model sense, but in Gabriel Tarde's sense of the sociologist as statistician; this statistician is a forensic scientist of possibilities, someone who presents the evidence not to satisfy the law beyond a shadow of doubt or towards certainty before a jury, but in order to defy the norms however they may be performatively realized.[13]

Effective critique is synonymous with a counter-testimony of a reliable witness. In the age of extralegal risk management, legal practice is intertwined with technical forms of expertise. In these conditions, the critical maker has to become a witness against the experts, able to give evidence against their predicted events before they happen. With this goal in mind, the critical maker – whether engineer, designer, or technologist – should bask in their technical skill and professional expertise, rather than transforming themselves into the artist as amateur.

I will conclude by returning to the example I began with. Two years after the exhibition of Heather Dewey-Hagborg's *Stranger Visions,* Parabon NanoLabs launched a DNA profiling service to be used by the police. The news of the launch lead Dewey-Hagborg to extend her

12 Bruno Latour, 'Why Has Critique Run out of Steam?', p. 246.
13 Gabriel De Tarde, *The Laws of Imitation*, Redditch: Read Books, 2013. pp. 89-101.

critical efforts and begin a new project that aimed to reveal the limitations of this phenotyping technology. The expertise she gained during the project allowed her to discover that NanoLabs DNA profiling is not accurate enough to be used in criminal investigations.

Stranger Visions embraces a certain aesthetic, making the viewer gawk at the spectacular possibilities of 3D printing. However, the critical element of the work lies in the way it undermines the extralegal tactics of the police, their reliance on shoddy DNA sampling to quantify and calculate the risk of crime. Dewey-Hagborg's critique, however, would not have been possible without drawing upon expertise in DNA profiling and computational practices that allow her to undermine the practices of phenotype risk management. By developing her proficiency in this field, Dewey-Hagborg became an expert witness, presenting scientific facts as counter-evidence before the exceptional circumstances of the law.

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Unmaking: Against General Applicability

Critical Media Lab (Merle Ibach, Michaela Büsse, Felix Gerloff, Viktor Bedö, Shintaro Miyazaki & Jamie Allen)

UNMAKING – AGAINST GENERAL APPLICABILITY

CRITICAL MEDIA LAB (MERLE IBACH, MICHAELA BÜSSE, FELIX GERLOFF, VIKTOR BEDÖ, SHINTARO MIYAZAKI & JAMIE ALLEN)

As belief in the applicability and efficacy of DIY production, open-source, and method sharing has broadened to include institutional hackathons and open-data-fueled and civic 'maker weekends', taking stock and articulating how certain approaches 'work' or 'do not work' within maker culture – and for progressive and expansive creator cultures more generally – continues to be essential. 'Making' is a key concept that frames a host of more specific practices, lending characteristic manual/moral, communal/communicational, aesthetic/ethical, and enacted/economic inflections and values. Even simple historical, traditional, technological, or digital acts of object and media creation, of art and design, but also of writing and thinking itself, can be recast as 'making'. What is it that happens to the thinking and doing of such activities, when such recasting is desired, chosen, projected, enforced, or assumed?

The use of, and reflection on, means of production and the shaping of materialities ignites potentials for understandings that are as fundamental and intrinsic as they are 'disruptive' and incisive to contemporary economies and assumptions of industrial societies. A fundamental difficulty arises through genealogies of making, as scenes, cultures, and epistemological framings, when such techniques become homogenized, universalized, and devoid of the specificity, situatedness, and necessarily tactical improvisations through which they needfully emerge. In the writings that follow, our contribution takes up both practical and theoretical considerations of critical making, and the always ambiguous and reactive stances for and against 'making' as a cultural lens, valuation, and rubric.

The specificity of diverse practices crumbles the edifice of 'making'. By recognizing the heterogeneity of *relations to* making, we are against its general applicability as concept, motivation, approach, and toolset. In these writings, we attempt means of breaking open 'making'. We recognize 'making' as a neoliberal, modernist shibboleth – even if, as a concept and motivation, it is still usefully distinct from centrally, mass-industrialist and productivist motivations, activities, and economics. Often a justificatory excuse that converts 'unnecessary' action into something necessary, that turns profligate endeavors into reasonable activities, it is the rhetorical edifice of 'making' itself that needs to be unconstructed, to be unmade. This process is necessary to determine which aspects of making and maker culture to keep, which we should just ignore, and which we should throw away. 'Unmaking' is a broad, reflexive, and critical framing that emphasizes the always ambiguous character of making, reversing operations that aren't always in themselves truly emancipatory or progressive, and providing mirror-reflections for design, art, and other undisciplined creation, when it is framed as 'making'.

We juxtapose four very different but resonant contexts, shorter explorations related to research currently under way at Critical Media Lab Basel.[1] We address these through different scales,

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1 In a workshop devised for Transmediale 2016, a team comprised of members of the Critical Media Lab Basel and collaborators problematized making in terms of five anxieties relating to *community,*

layers, and levels of materiality, beginning with additive design. This is complemented by discussions of the micro-level of our built, designed, and made environments through work on the materiality of sand and collaboratively made open source softwares and digital environments. Reflections on the epistemological dynamics of making and thinking-making follow. What kind of tradeoffs are made between the agility and transferability of practices, gained through systemic abstraction and generalization, and the material and bodily engagements and efficacies of individualized making? Idiosyncratic, individual explorations highlight how making (and unmaking) are not *one thing* but specific orientations that arise in practice, in materiality.

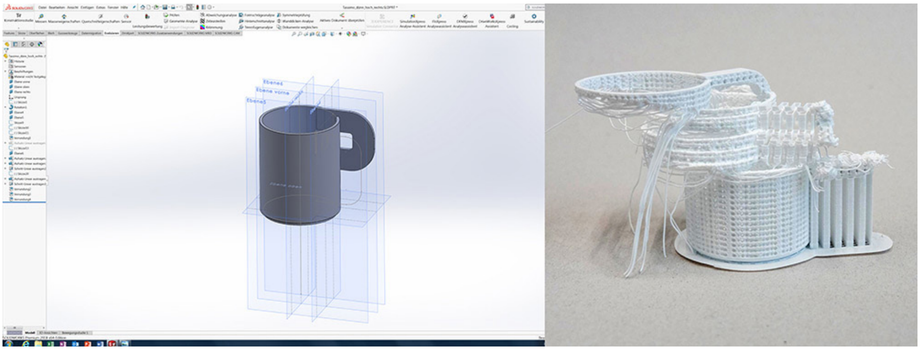


Fig. 1. Merle Ibach, virtual display of cup design and its 3D printed result, 2019.

Additive Design

3D printing is seen as an alternative to industrial manufacturing. It is a technique and technology charged with designerly as well as political promise. The potential for participation in, and democratization of, manufacturing processes, as well as a return of offshored production back to local communities and the unboxing of global supply-chains are amongst these promises.[2] Through innovation-driven experiments, technophilic supporters – from the amateurism of 'maker space' culture to engineering in the building sector, biotechnology, or aerospace industries – have projected practical, economic, and idealistic legitimacy onto 3D printing. Yet, the most common use of thermoplastic print technologies arises in prototyping practices, primarily in the Do-It-Yourself sector, an area which is neither industry oriented nor purely craft-based,[3] and develops little of the projected promise of maker-marketing characterizations. Even as 3D printing is poised to transform some design and manufacturing processes, perhaps even

responsibility, effectiveness, authenticity, and *kit-ification*. Questions raised included: is your experience of making sincere, legitimate, and genuine? How does making increase or reduce proximities, collectivities, autonomies, sufficiencies, and dependencies? How can we think 'outside the box' when everything comes in a box? Does making (need to) make a difference? Does making give us abilities to respond politically, ecologically, or economically?

2 Jesse Adams Stein, 'The Political Imaginaries of 3D Printing: Prompting Mainstream Awareness of Design and Making', *Design and Culture*, 9:1 (2017): p. 20.

3 Umweltbundesamt (ed.), *Die Zukunft im Blick: 3D-Druck: Trendbericht zur Abschätzung der Umweltwirkungen*, Dessau-Roßlau: Umweltbundesamt, 2018, p. 19. https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/fachbroschuere_3d_barrierefrei_180619.pdf.

fundamentally, the majority of produced artifacts are copies of existing objects. These copies no doubt reflect even more fundamental traditional social configurations, and will do so for the foreseeable and prolonged future. Very popular items of everyday use like vases, cups, simple mechanical parts, connectors, adapters, or decorative artifacts, are locked-in designs that originate under conditions of industrial fabrication, and are therefore unlikely to be manufactured in truly radically new ways. Additive manufacturing is explicitly defined by Jesse A. Stein as: '[...] part of a system of technologies that also encompass digital design (e.g. CAD files), feedstock (materials required to print matter, e.g. plastic spools), and associated digital and physical infrastructure (e.g. the internet, hardware, energy, space)'.[4] Additive manufacturing does not only mean the addition of layers of material onto a carrier plate: design education, designers, design tools, and material resources necessarily complete their qualities in a reciprocal symbiosis. It is a globally networked community, comprising the knowledge and practice of 3D printing, that embed themselves in and inform 3D additive manufactured designs, creating further layers of remixed, transcultural knowledge. Thought of as a *media* technology, 3D printing operations don't merely lead to new or alternative representations, but to fundamentally different design methods and experiences of design and making processes.

Critical Media Lab's Merle Ibach (Junior PhD Researcher) explores additive design processes and their ways of becoming. Merle's practice-based research explores two perspectives of additive manufacturing and 3D printing. On one hand, there are individual aesthetic expectations associated with 'virtual qualities' prior to manufacturing. 'Mathematical pureness' and independence from statistical variation and morphology are given by software paradigms and built-in settings. These are projected and infused when a physical model is made 'inside a computer' and then additively produced in the world. Ibach understands that growing up and living with ergonomic, standardized, mass-produced, industrial products creates tendencies for aesthetic homogeneity. On the other hand, there are aesthetic qualities that emerge within the sociotechnical negotiation of particular tendencies and interests across the spectrum suggested by actors like designers, CAD software, STL-files (a file format for unstructured polygon surfaces), ABS-Filament (the synthetic material, derived from petrochemical mineral oil), and 3D printers themselves. What Isabelle Stengers, a philosopher of science, has called 'reciprocal capture'[5] also describes a dual process of co-invention between a designer, a maker, and their tools. However, while imagined as being deterministic, computational scripts, additive manufacturing, and digital design are reciprocal processes that are never fully duplicated. The complexity of a first prototype, devised by one person alone, is manifested through a host of systemic translations and technological transformations.

'In the computer', within CAD software, wireframe models are constructed that do not directly link form, geometry, and materiality as it will manifest 'outside the computer'. Instead, these links are purely mediated. Exported as a STL-file, the dimension-driven

4 Stein, 'The Political Imaginaries of 3D Printing', p. 7.

5 Isabelle Stengers, *Cosmopolitics I: The Science Wars*, trans. Robert Bononno, Minneapolis: University of Minnesota Press, 2010, p. 36.

geometry of the vector-based model is algorithmically translated into surface polygons. This transformation, amongst other changes, creates flattened, fractured elements from curved and rounded surfaces. Elements can become grossly distorted in relation to the chosen degree of approximation (e.g. size and density of polygons). The STL file format often causes further syntax errors such as the doubling of object facets, gaps between them, or incorrect assignment of their orientations. The file is then translated by a 3D-printer software, into *g-code*. By slicing the model into layers, g-code contains data and instructions with parameters like speed, XYZ-coordinates, and material feeder movement, that later direct the stepper motors that move the print head. Through a nozzle as small as 0.25 millimeters, heated up plastic filament is applied to the build plate. In the process – imagined as a trajectory from imaginary representation toward physical manifestation – an in-computer model is filtered into simple geometrical shapes, reduced to polygon surfaces, sliced into layers, cut into short commands, and then finally reconstituted by hot, fluid plastic with a shrinkage rate of around 1%.

During preliminary design processes, relations are formed and values negotiated whose persistence are just as transient as they are 'rapid'. Whether printing a rare, mechanical connection, a complex, lightweight structure, a residential house, or an artificial coral reef, 3D printing embodies a promise – that at the end of every idealized design process there could, or should, be a 'Print' button. Even if every application, in practice, actually depends on another technology, all these applications are united in their basic operations. Controlled by software, a printer applies material, layer by layer, onto a substrate, and things appear. Particularly in prototyping operations, which is the iterative designing of possible 'solutions', thermoplastic print technologies accelerate the development process from first draft to a final (often commercial) product. *Media* materiality, as John Durham Peters points out, provides more than just organizational structures.[6] It shifts the paradigms of making, from ideation to design onward. Software is also continuously updated, so its experience underlies a constant relearning and refining. Virtual design environments are workspaces of endless iterations, of unhampered addition, removal, multiplication, and scaling. Due to automated production, design through additive manufacturing seems to us only determined by formal, aesthetic questions.

According to a report of the German Federal Environmental Agency, the overproduction and defective production of 'more or less value-free items' tends towards the creation of increased environmental pollution for humans and the environment.[7] A good deal of particulate matter is produced during additive manufacturing. Other issues include the toxicity of the materials that are used for the filaments and their lack of recyclability. Even the biodegradable plastic polylactide (PLA) that is often used as alternative to petroleum-based plastics like ABS can only be composted through special industrial procedures. Furthermore, the printers have high power consumption in proportion to their modest outcome of individual pieces. So far, 3D printing in total has a marginal impact

6 John Durham Peters, *The Marvelous Clouds: Toward a Philosophy of Elemental Media*, Chicago: University of Chicago Press, 2016.

7 Umweltbundesamt (ed.), *Die Zukunft im Blick: 3D-Druck*, p. 35.

on the environment when compared to industrial manufacturing.[8] But extrapolating its effects onto a larger scale points to additive manufacturing as a potential harbinger of a parallel ecological disaster.

3D printing is both a technology and a socio-ecological concept. Through the principles of 3D printing, distinctions between designer, manufacturer, distributor, and consumer become reconfigured and realigned.[9] The implicit regime programmed into additive manufacturing eradicates the materiality of an object during its design process. 'Making' here – marketers suppose – somehow loses its weight, its perfidy, its resistance. The material aspects of 3D printing are left in the background, shifting attention away from the material resources and chains of technical know-how and instrumentation required. In this imaginary of 'making', things can be fabricated from any sort of material, any sort of synthetic structure. The design ecosystem, simultaneously dematerialized and rematerialized, provokes changes and transfigurations to global ecosystems.

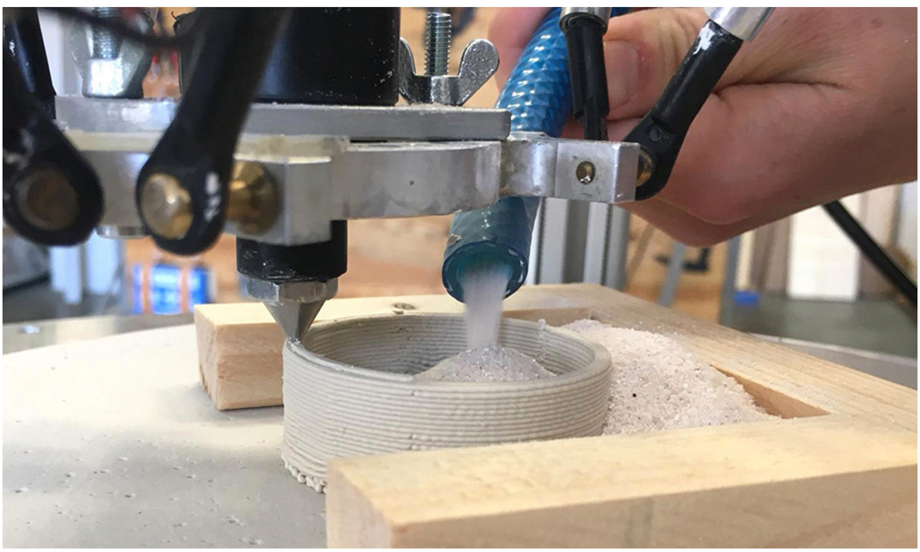


Fig. 2. Merle Ibach, ceramic 3D printer with improvised support structure of logs and sand, 2019.

Sand

Our second field of exploration is based on the practice-based study of the loose granular silicate material, sand. This work, conducted by Critical Media Lab's Junior PhD Researcher Michaela Büsse, takes a grain of sand as an inter-scalar vehicle for reflection and critical practice. Sand, as a substance, combines geological time with human time, ecology with economy with politics. Sand is both witness and object to 300 years of history, and it is of course not a uniform, real, or imagined materiality. Defined only by its grain size, desert sand is different

8 Umweltbundesamt (ed.), *Die Zukunft im Blick: 3D-Druck*, p. 35.

9 Stein, 'The Political Imaginaries of 3D Printing', p. 8.

from sand found in rivers or on beaches. Grain shape is rendered by environmental forces such as water and wind, and compositions can be a varied amalgam of shells, plants, and rocks. Sand contains disparate mineral compositions, consisting of quartz, magnetite, and other oxides, and is in high demand for engineering purposes. Because of its rich mineral composition, volcanic sand is of high economic value as well, particularly in places like Singapore and China, where the respective industries are concentrated. Sand is *becoming*: becoming land, becoming industrial zones, becoming electronic goods, as a medium and material of design and making. Japan, Singapore and Dubai use sand (also rocks, soil and cement) as infill to increase the territory of their nations.

In Tokyo Bay, one of the biggest land reclamation areas sprawls out over 480 hectares. On the Dubai coast, construction sites have added more than 100 kilometers of coastline and over 600 hectares of landmass. Singapore's territories have expanded from 58000 hectares to 71000 hectares, a growth in land of just over 22%. As opposed to diking – land reclamation by enclosure and water removal, practiced in the Netherlands since the 15th century – land reclamation by infill is additive manufacturing on a large scale. Ships get loaded with sand that is shot with high pressure through a jet, displacing and expanding seafloor into landmass. As floating 3D printers, they apply layer by layer of sand and instantly create new coastlines and tracts of land. 'Human activity has effectively created a new layer on the surface of the planet, made up of old bricks, cement, and rusting metal. Geologists and archaeologists have started calling this layer the archaeosphere'.[10]

Unmaking an archaeosphere, through these micro-trajectories, points to its materiality. From formation through to erosion and extraction, the material flow of sand unfolds itself. Its becoming is mediated through geological and human forces alike. Sand acts as a fluid medium. It is always flowing, until something prevents it from doing so. At that moment it crystallizes out as land, as buildings, as microchips – depending on the form that its composition takes and the role that modern infrastructures play. In its different formations, sand is constitutive of human life: the land we live on, the houses we dwell in, the digital infrastructures we rely on. The difference between a sand grain originating from the desert or the sea can only be observed through a microscope. Whereas erosion and segregation in rivers lead to irregular movement and thus an irregular shape, sand steadily moved by wind features a round shape. This round sand is considered useless for further industrial processing. Material value here is measured by economic value. Such measurements do not take into account the price of losing one's home, a habitat, or an ecosystem. Mining frequently causes ground subsidence, which in turn causes flooding, which eventually causes the disappearance of entire areas of land.

What becomes apparent when walking through the sand mines in Luzon and ending up in a white lab[11] in Singapore are the asymmetries and limitations inherent in all making. The unmaking of design, whether a microchip, a brick, a building, or an island – all

10 Emmett Fitzgerald, 'Making Up Ground', *99% Invisible*, 13 September 2016, https://99percentinvisible.org/episode/making-up-ground/.

11 A white lab is a sterile laboratory-like environment where microelectronics are processed.

human-made infrastructures – reveals what design covers up. The hidden infrastructures of extraction that keep sand in flow are brought to the foreground. Once they are made into a microchip, sand is forever short-circuited from its return to the riverbed. In enacting its potential for electronic processing, sand's original territory of an island is erased, soon disappearing altogether.



Fig. 3. Michaela Büsse, mining site for volcanic sand, close to Clark, Luzon, the Philippines, 2018.

Grafoscopio

Collaborative coding practices are an unmaking, a specific instance of descriptive yet productive deconstruction. For the purposes of analytical reconstitution, a group at the Critical Media Lab Basel seeks to open an investigation, one made possible by a coded script that accesses and evaluates data in the context of a software toolset for research. Potential applications include data journalism and the Digital Humanities. In contrast to the first exploration on additive design and 3D printing, where material aspects and the sociotechnical are hidden, here software is designed to reveal and unmake the digital environment it is built within and relies upon. This software toolset, called *Grafoscopio* (GS), is being developed at the Colombian hackerspace HackBo, which is located in the city of Bogotá. The space was founded in the year 2010 as a membership-based collective to foster engagement with a variety of technocultural matters such as DIY hardware projects, tinkering with Arduino, open source software projects, science and math, as well as internet activism. GS is conceived and coordinated by design researcher Offray Vladimir Luna Cárdenas and is:

> a moldable tool for interactive documentation and data visualization, that is being used in citizen, garage & open science, reproducible research, (h)ac(k)tivism, open & community innovation, domain specific visualization and data journalism, and has a lot of other potential uses. [...] Grafoscopio integrates simple and

> self-contained 'pocket infrastructures' that can be executed on/off-line from a USB thumb drive, a Raspberry Pi-like computer, a modest server, or any hardware in between and beyond.[12]

Grafoscopio is at once a note-taking application, a publishing suite, and an interactive tool for data exploration and visualization. It runs within the Pharo Smalltalk environment, an integrated operating system, development environment, and programming language. Similar to Oracle's Java, it can be executed on any hardware and in any operating system. Pharo Smalltalk is itself a community-based open source project and a contemporary incarnation of the historic programming language Smalltalk-80, developed in 1980 by Alan Kay, Dan Ingalls, and Adele Goldberg. GS derives its versatility mainly from its technological functionality. Like its more prominent relative, the Jupyter Notebook, it is possible to write and execute code within documents edited in GS. By providing this functionality, the hands of users such as journalists or academics are extended towards epistemic practices and techniques of unmaking. The software's functionality and basic Pharo Smalltalk coding skills can be learned through tutorials within the environment itself. However, the main way to get involved with GS is Data Week, a workshop format cultivating the development and use of GS.

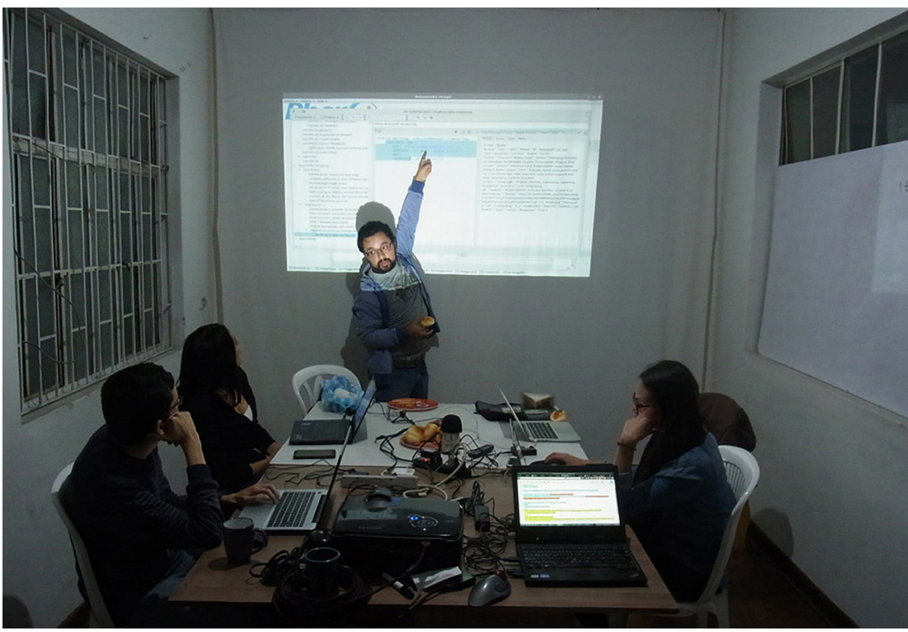


Fig. 4 Felix Gerloff, Luna Cárdenas and participants at Data Week 5, 2016.

While Luna Cárdenas is the main driver behind GS and has done the bulk of its programming himself, he regularly hosts Data Weeks at HackBo to introduce people to the environment and develop it further. Data Week sessions take up civic concerns in the context of Open

12 Offray Vladimir Luna Cárdenas, 'Grafoscopio: A Moldable Tool for Literate Computing and Reproducible Research', *The Journal of Open Source Software* 2 (October, 2017): p. 251.

Data and internet activism, that is, orientations toward legislative action and governmental campaigns on digital or environmental issues. Participants include software engineers as well as journalists and academics. One example of a basic critical exercise deployed within this format is the Data Selfie. Participants learn to call up data from Twitter profiles of themselves as well as politicians through the Twitter API and render so called Data Selfies – visualizing the quantitative relations between the tweets, retweets, and replies a profile has accumulated.

During these Data Weeks, the collaborative coding and making of a digital infrastructure enabled its users to practice an extended form of unmaking – deconstructing or analyzing as well as re-presenting, for instance, political rhetoric and stances. Data Selfies of some politicians, for example, revealed evidence of the unidirectionality of their communication on social media. This practice or set of practices characteristically combined the opening up of technological platforms, the cultivation of basic coding skills, the promotion of a rather quantitative data analysis approach (including visualization with a critical civic concern), the connection to political discourse, and community building. Collaborative coding, then, might also be a form of unmaking of knowledge hierarchies. Collectively, participants learn to break down the technological barriers of access to infrastructure and information, removing the hurdles faced by those not professionally trained in a technological field. Ultimately, such a modulation of practices by hacking might be an unmaking of these professional practices themselves, one that, in turn, reconfigures what it means to conduct journalistic or academic investigations.

Acknowledging the necessary context-specificity of unmaking, GS figures as a moldable tool that can be altered and adapted by its users. While it doesn't deploy glitches or subvert the logic of programming languages, like some of the examples of 'queer computing' in Jacob Gaboury's critical unmaking paper, this specific version of unmaking might nonetheless fulfill the requirements he formulates for such a practice: 'It would appear that queer computation cannot simply offer an antinormative critique of digital media. Instead, it must offer a reframing of the goals, drives, and interests of these media as technologies in which queerness is necessarily situated'.[13] Developing and deploying GS as a critical, subversive tool in social and political contexts contributes to establishing a somewhat antinormative approach to digital media and endows its users with the abilities to further understand and possibly unmake their basic protocols and formats.

Unmaking Making

Making has strong connotations of expansion and exploration, as well as reflection. Philosopher and urban planner Donald Schön's monograph *The Reflective Practitioner* is a text of high relevance for makers and their cultures.[14] Schön questions how action and reflection could ever be separated. Thinking and making constitute contiguously iterative loops of perception and proprioception, activation and reactivation, immersion and reflection. For

13 Jacob Gaboury, 'Critical Unmaking. Toward a Queer Computation', in Jentery Sayers (ed.) *The Routledge Companion to Media Studies and Digital Humanities*, New York: Routledge 2018, p. 486.

14 Donald Schön, *The Reflective Practitioner: How Professionals Think In Action*, London: Temple Smith, 1983.

all our talk of 'theory and practice', we have little practical evidence or substantial reason to separate these things. More specifically, to understand the relationship between applicability and context dependency in making, it is necessary to look at the various levels of abstraction that are activated, and at the constellations which emerge in thinking and making processes.

The main function of abstraction is to extract, but also to distance something from concrete experience and context. Abstraction is a strategy to enable easier manipulation, faster referencing, and finally general applicability in the sense of synthesizing theories that are applicable to a wider range to situations.[15] Making, on the other hand, is an utterly bodily and affective activity, a close engagement with very concrete materials and environments. Making is an arguably less abstract affair than, for example, thinking in mental imagery or allegory.

In dance, rehearsing choreography without carrying out every movement is more abstract than a final dance performance in front of an audience. Movements are carried out at a level of high abstraction when a dancer is sitting in the subway, on the way to a rehearsal, or going through the choreography with eyes closed. Even here, tiny micro-movements of the body are (re)enacted, a disposition to carry out future movement. The bodily reenactment of the choreography is carried out on different levels of mental-physical abstraction, and the resemblance between these is maintained throughout scale. The dancer might think of these physico-mental run-throughs as instances of the same choreography, as David Kirsch writes.[16]

According to theories of embodied cognition, the minimal or dispositional reenactment of past experiences are like the exercises of a dancer. We recall what we know – this is thinking with concepts. Alva Noë understands conceptual deliberation as abstract reenactment, a reproduction of past experience drawing upon a constellation of mental images, words, artifacts, and bodily movement.[17] Reenactments can be triggered internally as well as externally, and can manifest themselves in the production of things internally or externally. The empiricist philosopher Henry H. Price illustrates the principle of how these activations happen:

> [...] the 'activating' of any mental disposition is a matter of degree. Between the two extremes – complete latency and complete actualization – there are many intermediate degrees of sub-activation. When the word 'cat' occurs, or a cat-like image, a whole series of concepts linked in one way or another with the concept cat may be in some degree brought to mind. It is true of me at all times that I am capable of recognizing mice, bowls of milk, fur, tigers, mammals, hearth-rugs, at any rate [...]. At all times I have memories of what all these diverse entities are like (in the dispositional sense of the word 'memory'). But if the word 'cat' occurs to my mind – or a cat-image or a physical cat-replica – then something comes to be true of me which is not

15 See how Bruno Latour traces the subsequent stages of extracting/abstracting and theory making from a field trip in the rain forest to publication of a theory in: Bruno Latour, 'Circulating Reference', in Bruno Latour, *Pandora's Hope: Essays On The Reality Of Science Studies*, Cambridge, MA: Harvard University Press, 2000, pp. 24-79.

16 David Kirsch, 'Thinking with The Body', *Proceedings of The Annual Meeting of the Cognitive Science Society* (2010): pp. 2864-2869.

17 Alva Noë, *Action in Perception*, Cambridge, MA: MIT Press, 2004.

> true at all times. All these diverse memory-dispositions are to some degree excited or sub-activated. I am put into a state of readiness to recognize mice, bowls of milk, tigers, etc., if I should happen to perceive them; and also in a state of readiness to talk of such entities or produce images of them. I am ready to do these things, even though I do not actually do any of them.[18]

Price goes on to explain how producing and iterating on drawings and clay models varies in sketchiness or elaborateness, depending on how much knowledge we possess about that thing, or how much we are able to formulate the relevant details during this process. Notably, what we reenact during creative processes may vary in temporal and spatial scale. Parts of objects can be reenacted as well as whole objects (which are parts of other objects themselves).

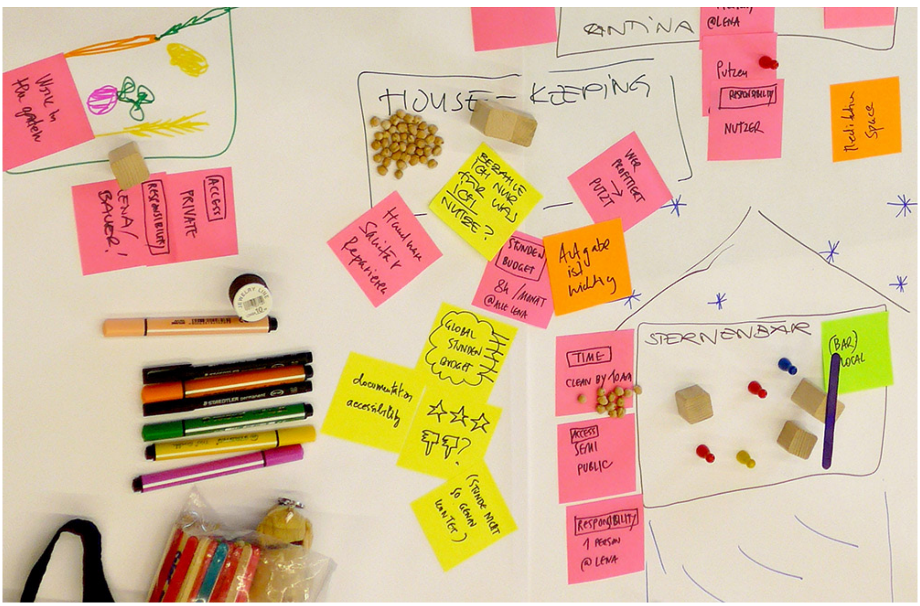


Fig 5: Viktor Bedö, SNSF-project "Thinking Toys for Commoning", collaborative unmaking-making of the bottom-up organization of house-keeping by members of a housing co-operative by combining things and tools (materiality) with words, figures and lines (abstraction), 2018.

In processes which emphasize making – rather than thinking – the maker is working with less abstract, cognitively *heavier* things, more embedded in a context and the circumstances of the process. The maker of a 3D-printed model of an island needs to have more detail than the creation of a mental image or a pencil drawing. The maker also has to be concerned with the qualities of the 3D printer's filament, the qualities of the tools, and the infrastructures being used. When making an island by pumping sand into the sea, more consideration must be given to the environmental context, the

18 Henry H. Price, *Thinking and Experience*, London: Hutchinson's University Library, 1953, pp. 137-138.

architecture and activities that will populate the island. As the materiality of the things increases, the time and effort we need to invest to manipulate these things will change drastically. Concomitantly, possibilities for embodied interaction increase, as meaningful interaction within a context and a surroundings, in the form of a richness of detail. As materiality increases, we lose abstraction, mobility, and general applicability.

A Non-conclusive Conclusion

These examples provide us with a fractal, splintered picture of making, unmaking, and related thinking and practices. New insights and designs emerge as weak links and faint activations in the making process. This is where the maker feels that something is not right with the picture or something might be missing. Our fingers itch to change a line, our eyes squint in an effort to refocus, things are rearranged to ease the tension. Past experiences of the maker guide our focus to various features of the material, the possibilities of the tools, and the affordances of the maker-in-space. New constellations like additive design trigger mental images or inspire sketches on paper – aspects co-activate each other by constantly rearranging the actual constellation of things. Here, implicit embodied knowledge, at the peripheries of our attentions, is pulled in and find its satisfactory place, setups in which makers find coherence between what they know about the world and what they anticipate. Tools, materials involved in the making process, and the space in which the making takes place – all these may differ in scale, but their power to activate and promote elements of these constellations are the same. Each project or project phase, framed as making or unmaking, locates itself somewhere on a continuum between contextualized and abstract, functionalization and curiosity, done for use or done out of 'pure' interest. In this, we resist the general characterization of these acts as 'making' or 'unmaking' and instead understand the heterogeneity of both as instantiated in each and every project or moment of engagement with and through materiality.

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Drawing on Theory to Build/ Unbuild Media, or Lalalalalalalalala

xtine burrough
<>
Lucy HG Solomon

DRAWING ON THEORY TO BUILD_UNBUILD MEDIA, OR LALALALALALALALALA

XTINE BURROUGH <>[1] LUCY HG SOLOMON

On Nov 15, 2018, at 1:41 PM, xtine burrough wrote:

Hey Lucy,

I was looking at this call and thought about a dialog with you – are you in?

xxxooo

On Nov 17, 2018, at 11:38 AM, Lucy HG Solomon wrote:

Hallo!

Yes, let's unbuild media! I've been thinking about my own sense of craft as part of technological building and thinking across networks. Each of our collaborations is built around a shared practice that is feminist in its core structure, involving a sharing of credit, a sharing of technologies, and a rethinking of how we work with(in) technology. Before us came women technologists/artists who did not get big salaries at companies and weren't proclaimed art stars like their male counterparts. They became educators and connectors.

We both critique capitalist systems through making – yours via usurping the existing system of digital workers (Figure 1), addressing issues of equity in a global workforce.[2] My work mapping microorganisms and using nature's logic to determine socioeconomic actions (with Cesar Baio, as Cesar & Lois),[3] plus LOIS'[4] last project on squirrel gentrification that talks about economic issues in areas of urban sprawl,[5] are also connected with technology's relationship to society (Figure 2). Your work with LabSynthE (Figure 3) is part of this.[6]

Those are my first thoughts!

Lucy

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1 Collaborative authorship attribution, with no first author.
2 xtine burrough and Sabrina Starnaman, *Return to Sender*, 2018-19, ongoing, http://www.visiblewomen.net/return-to-sender.html.
3 Cesar & Lois, *[ECO]nomic Revolution*, 2018, http://cesarandlois.org/economicrevolution/.
4 LOIS is the acronym for the art collective, The League of Imaginary Scientists, consisting of artists Lucy HG Solomon, Steve Shoffner, Jeremy Speed Schwartz, Matt Solomon, and Leonard Trubia.
5 LOIS, *Acornicopia*, 2018, http://acorns.imaginaryscience.org/.
6 LabSynthE, a laboratory for synthetic and electronic poetry, https://labs.utdallas.edu/labsynthe/.



Fig. 1. xtine burrough and Sabrina Starnaman, The Laboring Self, *The Center for Creative Connections at the Dallas Museum of Art, 2017-18.*

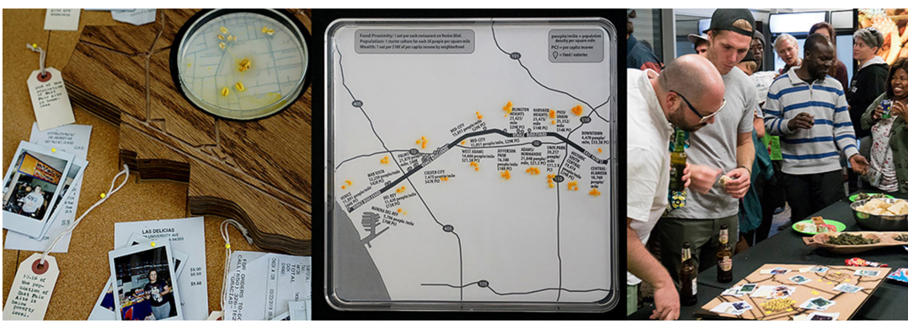


Fig. 2. Cesar & Lois, installation and happening of [ECO]nomic Revolution, *in which the socio-economic dynamics of a city's neighborhoods are both the variables for microbiological growth and the organizing factor for sharing food (left to right: Stanford, Los Angeles, Durban), 2018.*

On Nov 19, 2018, at 5:30 AM, xtine burrough wrote:

Hi Lucy,

Has your electricity been turned on yet? I'm so impressed you are working and writing while living through those great Santa Ana winds. You are a true pioneer woman!

My first techno-mentor was my father, a programmer for the NY Department of Transportation in the 1970s. He taught me Basic on a TRS-80 when I was eight. I think that was important for my understanding of how to be with technology: unafraid and experimental.

Many of my collaborations are with non-artists. I like being the artist/producer in the relationship.

For the artist, there is much to be gained from working with others outside our discipline, from areas of expertise they bring to the conceptual development of the project to the practical details. How do you prioritize some of these collaborative nuances?

Hugs,

xtine



Fig. 3. xtine burrough and Letícia Ferreira, The Radium Girls: A Radically Advancing Tour of the Exit Signs*, is one of the first projects developed in LabSynthE for Central Trak, 2017.*

On Nov 23, 2018, at 2:11 PM, Lucy HG Solomon wrote:

Dear x,

I sometimes really do feel like a pioneer woman, with the birds and horse and this land, but also an interloper in someone else's land – historically speaking. In another sense, we are both pioneering technologies. My women mentors showed me that you can carve new paths in technology in a human-centered way. Your father's legacy marks the normalization of making with technology.

What does it mean to be making art, poised as we are not just in the Capitalocene, but in the technologically saturated time of now? When you ask about shared practices, is that solely an aspect of making in this digital time, where the sharing of information is at the basis for most transactions? Networked transactions, cloud computing – our mechanisms incorporate a sharing

of technological entities. With Cesar & Lois, we share authorship across the network, with human actors and nature-based entities, prompting collaborations with labs and scientific researchers (Figure 4). Microbiological systems become the basis for our system of sharing.[7] The labor that you discuss, the division of the labor within the collective, becomes even murkier when we depend upon input from a nonhuman living organism, one whose authorship is unintentional.

Your work intersects with this as your collaborators are often 'invisible' and unvoiced, in certain ways, although perhaps your work is about manifesting those hidden voices, providing that channel? I am thinking of the digital labor workforce as well as the unnamed women in history.[8] In my work, nature is what becomes divorced from the human reality through the technological interface.

Happy Thanksgiving, the holiday of appropriation, a much loved art form if not cultural trope.

XX Lucy

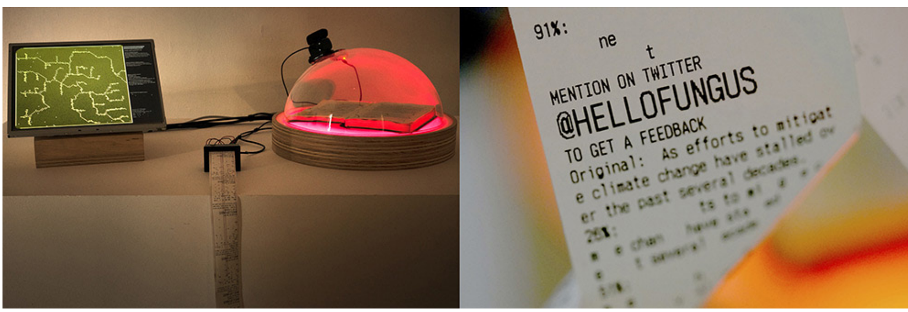


Fig. 4. Cesar & Lois, Degenerative Cultures, Uncommon Natures *at Brighton Digital Festival. Microbiological growth over a book and an integrated digital fungus that consumes Internet texts share information across the network and tweet the text that both 'organisms' redact, 2018.*

On Dec 3, 2018, at 12:07 PM, xtine burrough wrote:

Happy List Month, Lucy Mercury!

December is a time of lists: lists my kids make, lists organizing the semester, grading, letters of recommendation, final meetings, babysitter calendars so we can attend graduations and parties... So, another list:

1. I feel uncomfortable talking about my creative practice as critical making or research. What is it that we are doing? Are we researching through our practice? Are we 'just' practicing?

7 Cesar & Lois, *Degenerative Cultures*, 2018, http://cesarandlois.org/digitalfungus/.
8 xtine burrough and Sabrina Starnaman, *The Laboring Self,* 2017-18 http://visiblewomen.net/laboring-self.html and *An Archive of Unnamed Women, 2018-ongoing,* http://visiblewomen.net/unnamed-women/.

I wonder if critical making is art (or do critical makers consider themselves artists?) and if art can be critical making? Is one a subset of the other? Garnet Hertz operates as a researcher and artist from an artistic/interventionist position.[9] I read his work and I think, yes, I could be classified like this. But going back to its beginnings, Matt Ratto's description of critical making takes a more formal and research-driven approach with a clear boundary that runs up against making works for audiences or exhibition.[10] So then I think: no, this is not what I am doing. I ask these questions because it is so common for us to have a crisis of name/identity, a crisis I remediate in projects such as *An Archive of Unnamed Women* (Figure 5) and *The Women of El Toro* (Figure 6).

2. You asked about making art with technology now: I read philosopher Katherine Hayles' call to 'put back into the picture the flesh that continues to be erased in contemporary discussion about cybernetic subjects'[11] as one that demands action. Much of the work we have made during the past fifteen years calls into question the role of the body in a networked community. Our work translates the possible realities and interconnections among the digital/virtual/living form.
3. Each time I write 'posthuman' my Mail application changes it to 'postman'. This fosters a terrifically funny riff. The postman has become posthuman/is not delivering you this letter/the posthuman mail agent always rings twice. To make digital art, as pioneering feminists in the Capitalocene, is to enliven our subjectivity, to include in our work the ways forward for viewers, participants, onlookers, and naysayers to be richly entangled in the virtual and the physical: to be present[12] and to present the digital as part of the patterning in communication with physical systems and ways of being.
4. My shopping list: Hatchimals and Morfboards; yours: pink dolls with pink accessories and spaghetti bikes. We can do this, momma.

Big love,

x

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9 For instance, Hertz writes, 'My interest in the term critical making comes from a perspective of hands-on technology development and studio practice: flipping the emphasis of the hands-on augmentation of critical technology studies to appeal to 'makers' to be more critically engaged with technology', in: Garnet Hertz, *Conversations in Critical Making,* Blueshift Series, Theorizing 21c, CTheory: 2015. https://journals.uvic.ca/index.php/ctheory/article/view/15123/6206.

10 Ratto is credited for first publishing the term 'critical making'. He writes, 'Critical making emphasizes the shared acts of making rather than the evocative object. The final prototypes are not intended to be displayed and speak for themselves', in: Matt Ratto, 'Critical Making: Conceptual and Material Studies in Technology and Social Life', *The Information Society: An International Journal*, 27.4 (2011): p. 253.

11 N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics,* Chicago: University of Chicago Press, 1999, p. 5.

12 'Be here now' invokes a reference to an inspirational film from the 1970s, *Being There* – which is also the name of one of my (xb) favorite CDs, Wilco's 1996 two-disk breakout record release after *AM* didn't hit the charts as fiercely. The CD is named after the film about a gardener whose simplicity is interpreted as genius. Wilco captures the contradictions of being here (physically) and there (mentally) sonically and with lyrics like, 'When you're back in your old neighborhood; The cigarettes taste so good; But you're so misunderstood [...]'.



Fig. 5. xtine burrough and Sabrina Starnaman, sample page from An Archive of Unnamed Women, *online project and prints for exhibition and workshop, 2018-ongoing.*



Fig. 6. xtine burrough and Dan Sutko, screenshot from The Women of El Toro, *iOS locative media application to insert oral history audio recordings of women who lived on the El Toro air base in Orange Country, California before it became a public park, 2016.*

On Dec 6, 2018, at 11:53 AM, Lucy HG Solomon wrote:

x!

As artists, it is strange how the past punctuates our present and emerges in later utterances and in different manifestations. I first knew philosopher Vilém Flusser through his and zoosystemician Louis Bec's creatures, which influenced LOIS at our inception in 2006.[13] Though Cesar & Lois formed more than a decade after LOIS, Flusser was also part of that. Cesar Baio's scholarship centers around Flusser's theory of technology – an apparatus that is indicative and predictive of societal outcomes.[14] As a result, our collective's reshaping of technologies – the merging of microbiological and digital logic systems (Figure 7) – has the utopian goals of reshaping society. i.e. *What if our computers think like nature*?[15] *And what if our computer connections are integrated with nature's conduits?*

As a media – in between – artist, the connections are crucial. Work that crosses biology with technology begins to shift what the medium itself can be, pushing us past interactivity and towards a more existential pondering of how we connect and how the forms of those connections pose new possibilities – for thinking, acting and being.

I also think about what it means to be a digital artist and posthuman (which yes, mine also auto-corrects to postman!), and I lean towards the nature-based, non-anthropocentric drive to become less human or to unbecome human. Like Hayles, philosopher and posthuman theorist Donna Haraway articulates cyberfeminism, and she advances nonhuman priorities and processes.[16] In her Chthulucene, humanity is no solitary figure in the planet's history but is one among 'assemblages of organic species'.[17] She is one of many working to deconstruct the human/nature binary; world systems theorist Jason W. Moore does so when he defines Capitalism as 'a way of organizing nature'.[18] In the different hybrid experiments by Cesar & Lois, where a technology's logic system is based on microbiological growth, we are reacting against this self-imposed binary and critiquing the recoding of nature.

That Chthulu/Anthro/Capitalocene of the present epoch is one that I see your work as both defined by and defining, especially in the connection between the exploitation of workers and the global economic system in which we partake. What is fascinating to me is that it is no longer possible to use technology as a critical medium and not interact with and comment on those systems of exploitation – of nature and of people(s). Your last

13 Vilém Flusser and Louis Bec, *Vampyroteuthis Infernalis: A Treatise, with a Report by the Institut Scientifique De Recherche Paranaturaliste*. Posthumanities 23. Minneapolis: University of Minnesota Press, 2012.

14 Cesar Baio, 'O Filósofo Que Gostava De Jogar: o Pensamento Dialógico De Vilém Flusser e a Sua Busca Pela Liberdade', *Flusser Studies* 15 (2012), p. 10.

15 Cesar & Lois, *Degenerative Cultures*, 2018, http://cesarandlois.org/digitalfungiconcept/.

16 Donna Haraway, *When Species Meet*. Posthumanities 3. Minneapolis: University of Minnesota Press, 2008.

17 Donna Haraway. 'Anthropocene, Capitalocene, Plantationocene, Chthulucene: Making Kin', *Environmental Humanities* 6 (2015): p. 159.

18 Jason W. Moore, *Capitalism in the Web of Life: Ecology and the Accumulation of Capital*, London: Verso, 2015, p. 78, pp. 191-2.

note, about the lists of things that our kids want, is tied to this system. The consumerism that we participate in is so different from the past, when objects held value, were made and traced to a source. The family tree of things is my personal project, which elevates items that have crossed me that can be traced back generations, even in one instance a bed frame originated in a tree felled by my great-grandfather.

But not anymore, not so much. Looking for that pink doll with more pink shit.

!

LHGS

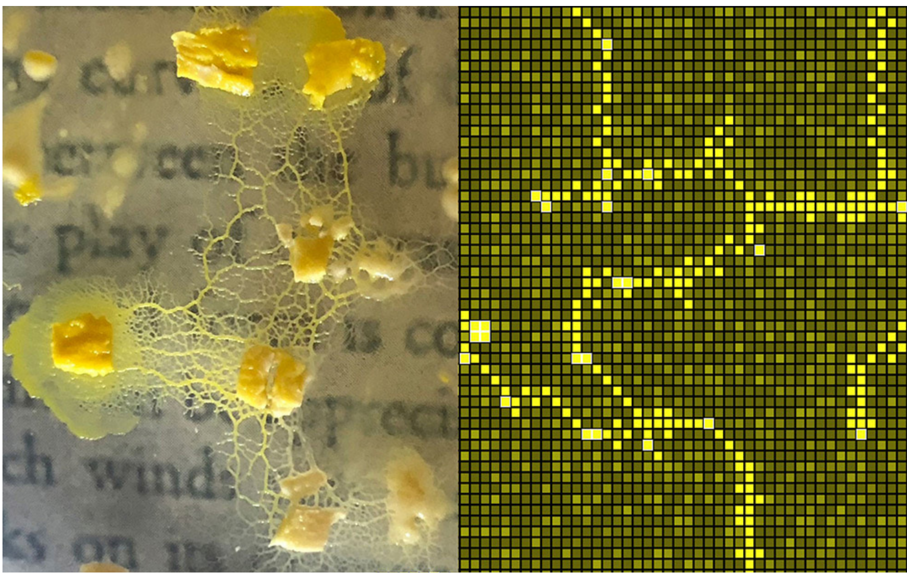


Fig. 7. Cesar & Lois, Degenerative Cultures, *in which the digital system of Degenerative Cultures is trained on the growth of the living organism Physarum polycephalum, 2018.*

On Dec 10, 2018, at 4:41 PM, xtine burrough wrote:

Hi Lucy!

This notion of intervening in the medium, maybe even in Flusser's 'apparatus', to me, is just another way to follow David Byrne and Jonathan Demme's creed to 'Stop Making Sense'.[19] I am inspired every time I sing along to:

I got a girlfriend with bows in her hair And nothing is better than that (is it?)[20]

19 *Stop Making Sense.* (dir. Jonathan Demme, 1984).
20 Talking Heads, 'Girlfriend is Better', *Speaking in Tongues*, 1983. Did you know that Robert Rauschenberg won a Grammy Award for his limited edition LP version of this album? Sometimes these worlds collide.

Byrne's gesture towards bows, it is serious! What does it mean to wear bows in your hair? What kind of a girlfriend would you be if you resisted bows or scrunchies or long hair or bangs? How do you make sense of this apparatus?! I riff between theory and practice, between the text on my bookshelves and popular song lyrics. Christine Harold writes about culture jamming as a form of musical riffing.[21] 'Jamming' with art and culture, between the art historical, the philosophical, and popular culture – from Flusser to Harold to Byrne – offers us a method for riffing ourselves right into a series of punctuations.

The world needs more opportunities to stop making sense in all the same ways. The rebellious, anti-logical spirit of the Situationists echoes through anti-pop songs. From David Byrne's wisdom in the 1980s to David Lowery's in the 1990s – both would have made Guy Debord proud. I've always interpreted this part of Lowery's song as a suggestion to keep riffing. His 'lalas' are voice-centric, yours and mine take material form:

What the world needs now Are some true words of wisdom Like la la la la la la la la-la[22]

xx

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22 Cracker, 'Teen Angst (What the World Needs Now)', *Cracker*, 1992.

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Tactics for a More-Than-Human Maker Culture

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TACTICS FOR A MORE-THAN-HUMAN MAKER CULTURE

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Maker culture promised to challenge models of production, consumption, and dissemination by democratizing the tools and spaces of production, as well as sharing knowledge. But ever since its inception, maker culture has existed within an anthropocentric paradigm. Our current environmental, political, and social circumstances require us to fundamentally rethink our approach to making. Making is not a neutral act, but one with environmental, political, and social consequences.

How can practitioners respond to this? What tactics can we apply to challenge the current state of things? We challenge the notion of the 'maker' that has been asserted in predominantly Western culture – a figure constructed from a supposed evolution in digital technological capacity and a subsequent liberation of human potential for creativity and innovation.

The Maker 'movement' claims to promote meaningful change, challenging asymmetric power structures and granting consumers a new potential to short-circuit the traditional production cycle. We address these claims by using examples of making practice that predate or contradict this conception of maker culture. In drawing on these practices, we call into question the model of a maker, one driven by neoliberal concerns of market innovation and disruptive technologically-enabled entrepreneurship. While promoted and exported as an essential model, the maker who controls their material with novel technological tools is a very particular one.

As a counterpoint to this, we use new materialist and posthuman theories to reposition the maker amongst their materials, tools, and environment. Entangled within this milieu, the maker becomes an equal creative partner, addressing the complexity and vitality of assembled matter and the interrelations between the organic and the inorganic, between the human and the nonhuman. This response is a reaction to the limiting humanist framework that has failed to critically address the pervasive influences of late capitalism and its disastrous ecological consequences.

To this end, we explore examples of making practices that work tactically rather than strategically. Tactics, as defined by Michel de Certeau, are distinct from strategies. For Certeau, a strategy is best described by considering the totality of a particular set of force relations that can be seen as distinctive from an exterior set of force relations: 'the calculus of force-relationships which becomes possible when a subject of will and power (a proprietor, an enterprise, a city, a scientific institution) can be isolated from an "environment"'. [It can] 'serve as the basis for generating relations with an exterior distinct from it (competitors, adversaries, "clienteles," "targets", or objects of research)'.[1] Strategies are articulations of power that take the shape of institutions, which in turn determine the actions of the people that inhabit them.

1 Michel De Certeau, *The Practices of Everyday Life,* Berkeley: University of California Press, 1988.

Tactics, on the other hand, are not a totality and cannot be defined through locative force relations. Neither can a tactic define itself against the totality of the other: 'A tactic insinuates itself into the other's place, fragmentarily, without taking it over in its entirety'.[2] Tactics turn events into opportunities. As Certeau stresses: 'The weak must continually turn to their own ends forces alien to them'.[3] If events emerge from strategies, tactics are the means used by people to turn those events towards their own needs. Tactics are more fleeting, and exist outside of ownership, making them more inclusive.

A Maker Culture

Maker culture has its roots in DIY and open source approaches to cultural production, ideals of individual empowerment, and a focus on reproducing community and social relations. The success of this particular maker culture is associated with the rise of makerspaces and FabLabs. These often not-for-profit or community-run spaces would include a selection of machinery such as 3D printers, laser cutters, and CNC mills/routers alongside traditional machine and hand tools, and possibly include other making facilities for textiles, electronics, or food. Increasingly these spaces are found in libraries, schools, universities, and research centers, where they have had to adapt to the more hierarchical organizational structures of the host institutions. Contingent on the location and organizational structures of their hosts, these hosted spaces have tended to orient themselves towards openness and fair access through subsidies and outreach programs. However, this has had only marginal success. Such spaces fail to extensively appeal to or reach a diverse user base, instead attracting mostly those who are white, male, and have financial means.

During the last two decades in North America and Europe, makerspaces, maker publications and the subsequent claims of technologically-driven progress have surged and been given the status of a 'Maker Movement'. The term 'movement' implies a social movement as much as a technological evolution – and according to some advocates and enthusiasts of European and North American maker culture, that is precisely what it is.

This movement found a voice through the popular 'Make' publication and Maker Faires. The proliferation of the magazine and Maker Faires (part of the Maker Media business) around the world is a story of success measured in terms of brand and marketing reach. The magazine is affiliated with O'Reilly Media and headed by CEO Dale Dougherty, a figure who is credited with popularizing the maker movement in the US and who was recognized by the White House as a 'Champion of Change' in 2011. The language used by high profile figures such as Dougherty and Chris Anderson, author of *The New Industrial Revolution*,[4] re-enforce ideas that the maker movement will lead to self-actualization, allowing individuals to realize their creative potential and become autonomous economic subjects. This rhetoric, together with the extensive reach of these individuals and businesses, supports a techno-myth that, amongst other claims, suggests that 'through the democratization of digital tools, "making" has become a universal element of human identity'.[5]

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2 Michel De Certeau, *The Practices of Everyday Life.*
3 Michel De Certeau, *The Practices of Everyday Life.*
4 Chris Anderson, *Makers: The New Industrial Revolution*, New York: Random House, 2013.
5 Kaitlyn Braybrooke and Timothy Jordan, 'Genealogy, Culture and Technomyth. Decolonizing

In 2006 'Make' magazine published a Maker's Bill of Rights that positions itself against the interests of the corporate consumer industry. It impresses upon makers the responsibilities and opportunities to create consumer goods that counter proprietary practices such as planned obsolescence and restrictive warranty conditions, practices that encourage short lifespans and prevent repair and customization. Such proprietary practices are made material through software (forced updates outrunning the performant capacity of the hardware), hardware (glueing components, causing them to break when pried apart and proprietary 'pentalobe' screws, which cannot be removed) and legislation (copyrighting schematics and manuals).[6] The Bill of Rights suggests ways of making that are antagonistic to these corporate mass production approaches and advocates changes that empower producers and consumers. These rights align with those of the free software movement, who advocate the basic freedom to study, change, and redistribute any software. Although it was not universally successful, the free software movement did instigate a significant proliferation of making practices in software development that contradicted the proprietary and predatory practices of corporate software companies. In contrast, it is difficult to identify the same success within the maker movement.

The technological evolution that has supported the maker movement has reinvigorated craft practices and expanded the productive capacity of small scale businesses and institutions. However, there has been limited meaningful change to corporate mass production. Neither has there been a significant expansion of access to making facilities (excluding existing practitioners and those with the available financial and cultural capital). This lack of significant social change contrasts sharply with the celebrated success of maker spaces such as Highway 1 in San Francisco, which is proclaimed to be: 'One of the most ambitious of those collaborative spaces'.[7] Highway 1 may be a successful space in terms of a business incubator and accelerator. However, its success is measured not in terms of progressive social change, but primarily in terms of capital investment and stock value. This type of space – in both its associated maker culture and the model of maker it maintains – are the product of an American neoliberalism and a techno-determinism that places a false sense of power into the capacity of technology to make positive social change.

Maker culture promised to bring about shared knowledge, rethink our relationship to consumption, and challenge the power relations inherent in the production of consumer goods. But in its pursuit of promoting itself as a culture, it forgot to reflect on the institution it was establishing. In its aim to become a valued element of contemporary culture, it unwittingly reinforced a set of hegemonic power relations. These relations, in turn, maintain contemporary cultural, political, and environmental practices that are unsustainable and unequal.

Western Information Technologies, from Open Source to the Maker Movement', *Digital Culture and Society* 3 (1) (2017): 25-46.

6 Oscar Schwartz, 'Sidestepping Apple: the third-party tinkerers fighting for your right to repair', *The Guardian*, 8 May 2019, https://www.theguardian.com/technology/2019/may/08/sidestepping-apple-the-third-party-tinkerers-fighting-for-your-right-to-repair.

7 James Fallows, 'Why the Maker Movement Matters: Part 1, The Tools Revolution', *The Atlantic*, 5 June 2016, https://www.theatlantic.com/business/archive/2016/06/why-the-maker-movement-matters-part-1-the-tools-revolution/485720/.

More-Than-Human Making

So far, we have described a highly constrained maker culture – one that does not extend beyond the geographic regions of North America and Europe, one focused exclusively on novel technologies and digital processes, and one that is solely the domain of makers cast in a hobbyist or entrepreneur mold.

This myopic view of maker culture reduces the scope of possibilities and excludes many cultural practices. Another, broader set of practices will be discussed here and read through theories that consider a 'more-than-human' arrangement of 'material, technical, and intensive objects and processes'.[8] Posthuman and new materialist theories contest the assumption that the ability to affect or be affected is the domain of organic matter only, suggesting instead that the material world can be understood as an assemblage where 'nonhuman technologies and natures are as much part of society as humans'.[9] Proposed by Rosi Braidotti, critical post-humanism is built on feminism and post-colonial theories and adds a level of accountability and subjectivity to the discussion. Braidotti defines the 'critical posthuman subject within an eco-philosophy of multiple belongings [...] as a subject that works across differences and is also internally differentiated, but still grounded and accountable'.[10]

This reading considers a framework for maker culture that explicitly recognizes the non-human vitality within materiality, and also acknowledges practices that construct subjectivities not bound to the concept of the individual, but as continuously forming. Continuously forming subjectivities necessarily blur opposition and boundaries that can exclude and marginalize, offering a complex, diverse, and more inclusive framework from which to act. The concept of the posthuman enables us to rethink our power relationships and 'greatly expand our understandings of the multiple agencies, dependencies, entanglements, and relations that make up our world'.[11] It makes it possible for us to consider our being in the world beyond binary divisions of human versus non-human agency.

Affective Making

The maker movement is scaffolded on an array of advanced digital fabrication technologies that have emerged from a culturally and geographically narrow area of the world. This particular flavor of maker culture is predicated on a primarily American narrative of software and hardware industries and commercial success. According to this technological fable, innovative firms create products that change the world for the better. However, in recent years this Silicon Valley narrative has been challenged by a series of indiscretions and abuses of power. These often reveal that these companies' primary motivations are high valuations and profit margins

8 Amit Rai, 'The affect of Jugaad: Frugal innovation and postcolonial practice in India's mobile phone ecology', *Environment and Planning D: Society and Space* 33(6) (2015): 985-1002.

9 Michael, Mike, *Actor-Network Theory: Trials, Trails and Translations*. Thousand Oaks: Sage Publishing, 2016.

10 Rosi Braidotti, *The Posthuman*, Cambridge: Polity, 2013.

11 Laura Forlano, 'Posthumanism and Design', *She Ji: The Journal of Design, Economics, and Innovation* 3(1) (2017): 16-29.

along with the proliferation of a cyber-libertarian philosophy. Similar techno-deterministic attitudes can be found embedded in maker culture, attitudes that exclude other practices and cultures from around the world that do not fit this narrative.

One example is the widespread practice, derived from India, known as *jugaad*. The meaning varies depending on context and usage, but can be described as a type of frugal innovation or a 'hack'. In contrast to the maker movement predicated on particular digital technology and access to specialist spaces, the practice of jugaad is commonplace and is performed as a necessary response to obstacles that occur within everyday life.

Contrasting jugaad with Western-style maker culture should not be understood merely as an opposition of making via emerging technologies versus making as 'frugal innovation' or with 'low-tech' means. Instead, examining jugaad-style making demonstrates an alternative situated practice. Here, making is driven by environmental and economic conditions of necessity, rather than leisure or profit-driven innovation.

Jugaad describes a type of activity that often responds to problems with a creative solution, fix, or workaround. In contrast to the Western model of making enshrined in curated making spaces, with specialized tools and a single-minded intent, jugaad-style making practices are experiments in augmenting, repairing, or improving domestic and community spaces with informal methods of making-do using reappropriated or recycled materials. This type of making is not facilitated in purpose-built workspaces, guided by prescribed methods, or accomplished using standardized tools. Instead, jugaad-style making is about subverting design thresholds, pushing against engineering principles, and exploiting opportunities within the fabric of the environment or technical infrastructures.

These workarounds can also involve exploiting the non-physical substrate of consumer products and networked technologies. Take, for instance, the simple but commonplace practice of using 'missed calls' to avoid a connection charge. Here layers of network hardware and protocols, subscriptions tariffs, and the mobile phone itself are augmented by a nuanced grammar (or protocol) of 'beeping' patterns that have been predetermined by phone users.[12] This jugaad is an arrangement of existing technologies, a response to economics conditions that creates 'differentials across capitalist innovation and subaltern practices of everyday life'.[13] It is the application of human ingenuity within a complex media ecology. Ecology can be understood to refer to the media ecology of the mobile phone and associated networked communication systems, but also to the jugaad ecologies as a whole that 'affect a passing from stasis (obstacle, law, hurdle, blockage, problem) to improvisation (passage, exit, trick, movement)'.[14] To affect this change from one state to another is not a capacity reserved only for human agents in this complex ecology. Conceiving of organic or inorganic agents as holding latent potential to act on each other describes an

12 Jonathan Donner, 'The Rules of Beeping: Exchanging Messages Via Intentional "Missed Calls" on Mobile Phones', in *Journal of Computer-Mediated Communication* 13(1) (2007): 1-22.

13 Rai, 'The affect of Jugaad'.

14 Rai, 'The affect of Jugaad'.

affective capacity. This is a useful way to frame jugaad and making practice more broadly, including the way agency is distributed within human, material, and technical interactions. Jugaad-style practices are often an exercise in exceeding the design of technical objects, which is possible because these objects have a 'homeostatic autonomy that exists outside of any one human's grasp'.[15] These practices – which include overcoming the expected conditions of use or restrictive access to technical assemblages such as mobile phones, for example – are reminiscent of tactics that oppose or insert themselves into institutionalized relations of power, tactics echoed in the Maker's Bill of Rights that state an opposition to the institutionalized forces of production.

Vibrant Making

Another example of an alternative making practice is drawn from an observational research study of an artist. Felix Larsen-Jensen uses a bricolage approach to analogue electronic music production, creating tools and instruments from assemblages of recycled materials, found objects, and electronic components. Larsen-Jensen is identified as part of a maker culture and perhaps even self-identifies as a maker. However, the relationship to his materials is driven by their animate qualities and their contingent properties within a chaotic environment. Such an approach to making, materiality, and the environment has more in common with jugaad than with a makerspace or FabLab in their common Western-centric configurations.

This difference is proposed as part of a wider shift to a neo-animist ontology, a concept drawn from Jane Bennett's book *Vibrant Matter*.[16] She asks the question 'what if materiality itself harbors creative vitality?' and critiques the conception of matter as subject only to 'mechanisms' or 'autonomisms' that treats the things of the world as inert and determined only by human-made forces. She argues that there is an energetic vitality inside all things that she calls 'thing-power'. This power or vibrancy, she explains, 'mean[s] the capacity of things – edibles, commodities, storms, metals – not only to impede or block the will and designs of humans, but also to act as quasi-agents or forces with trajectories, propensities, or tendencies of their own'.[17]

In the research findings, the DIY practitioner demonstrates a codependent relationship with his workshop environment,[18] where the collision of parts, materials, and space are more important for the creative emergence of difference-in-itself than an efficacious approach to materiality where manipulation of materials, understanding of tools, and expected outcomes are exclusive only to human agency. The practice and creative outcomes of the artist are extremely entangled with the materials, which exhibit a latent capacity for affecting his own agency and the outcomes of the work.

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15 James Ash, 'Technology and affect: Towards a theory of inorganically organised objects', *Emotion, Space and Society* 14 (2015): 84-90.

16 Jane Bennett, *Vibrant Matter A Political Ecology*, Durham, NC: Duke University Press, 2009.

17 Bennett, *Vibrant Matter*, viii.

18 Emit Snake-Beings, 'Maker Culture and DiY technologies: re-functioning as a Techno-Animist practice', *Continuum Journal of Media and Cultural Studies* 32 (2) (2018): 121-136.

An interesting observation from this study is made at the local refuse center where the artist salvages many of his materials. The discarded objects available in this space are arranged not by their original use or function, but by their most abundant material quality. This leads to unexpected adjacencies such as 'birdcages, deckchairs, and Zimmer frames'.[19]

Separated from their original function, these decontextualized objects open their material capacity and exceed the thresholds of their original design. An example of an assemblage created by Larsen-Jensen is a discarded aluminum pie dish combined with – amongst other components – a control potentiometer for modulating an oscillating sound output within a given range. In Larsen-Jensen's 'pie dish oscillator', the potentiometer has started to degrade, and the formerly discrete entity begins to have unexpected effects on the output, 'varying from harsh metallic grinding sounds, to a sound similar to fluctuating hissing steam, which sporadically and unpredictably resumes a pitched tone'.[20]

Although the potentiometer may have degraded because it had been manually modified by Larsen-Jensen, the multitudinous ways that the internal materials and components pull and push against each other – degrading material properties, changing the flow of electrons, and distorting the subsequent sound output – are all processes generated outside of human agency. This brings to mind Bennett's discussion of encounters with various objects, particularly her story of debris found in a storm drain and the energetic vitality inside it. She recalls that: 'In this assemblage, objects appeared as things, that is, as vivid entities not entirely reducible to the contexts in which (human) subjects set them, never entirely exhausted by their semiotics'.[21]

Outside of opportunities afforded to creative practice by a co-constitutive practice between humans and non-humans, what are the benefits of introducing a vitality to matter? Within Bennett's thesis for a political ecology of things, she suggests a motivation that lies within our 'human hubris' when we consider matter as 'dead or thoroughly instrumentalized', which leads to a lack of attentiveness to our material and ecological conditions. Bennett wishes to promote 'greener forms of human culture and more attentive encounters between people-materialities and thing-materialities'.[22] Without doubt, a wholesale change in attitudes toward the relationship between humans and the environment is necessary at this critical moment, and the restructuring of material culture can play a key role in this transformation. A making practice that considers the vitality in material suggests a positive attentiveness to materiality, but what does an ontological equality between humans and objects exclude? When everything has 'thing-power' we should not ignore the fact that not all actants have the same legible effect.

19 Snake-Beings, *Maker Culture and DiY technologies.*
20 Snake-Beings, *Maker Culture and DiY technologies.*
21 Bennett, *Vibrant Matter*, 5.
22 Bennett, *Vibrant Matter*, x.

Situated Making

The maker movement is a predominantly Western phenomenon: 'What is called "making" in North America and Europe is frankly a luxurious pastime of wealthy people who rightly recognize that their lives are less full because they are alienated from material culture, [yet] all over what is called the Global South there are makers everywhere, only they are not called makers. There are fab labs everywhere, only they are not called fab labs'.[23]

Looking beyond a Western viewpoint, there are ample examples of practices that present characteristics of the maker movement in their approaches to social and technological evolution, challenging existing models of production, distribution, and consumption through the democratization of tools and processes.

Ushahidi, which translates as 'testimony' in Swahili, is one such example. Ushahidi is a non-for-profit technology company that uses crowdsourcing to collect data and map responses in situations of crisis such as human rights reporting. It gives voice to otherwise marginalized people and decentralizes media reporting. It was developed to map reports of violence in Kenya after the post-election violence in 2007. Ushahidi aggregates data from key social media platforms with its own custom data from surveys via smartphone apps and SMS submissions. Assembling this data allows the company to generate useful, timely information in territories where state actors may struggle to intervene. It combines citizen journalism with geospatial information to empower communities.

This kind of platform can have significant social impact, making communities more resilient and supporting social institutions struggling for funding in areas facing economic and environmental stress. The social impact of supporting free and fair elections cannot be underestimated, and this is why the UN dedicates significant resources to these efforts. By crowdsourcing data collection, Ushahidi provides a platform for decentralized media reporting and facilitates collaborative content production. In doing so it provides a key example of a locative and situated practice – a practice applied in the very community where it was conceived and developed.

These examples push against the notion that, by setting up fab labs and makerspaces and by providing communities with CNC machines and 3D printers, the world would become a better place. The first ever cover story by 'Make' magazine in Volume 1 was dedicated to Kite Aerial Photography (KAP). Along with a detailed account of how to build your own KAP Kit, the story included a first-hand account of using it, and featured accompanying photographs of coastlines, children's playground structures, and restored World War 2 supply vessels. No mention is given to the different sites photographed, nor the juxtaposition of such different sites in a magazine – let alone issues of privacy and surveillance. Here, making is framed as an individualistic pastime, an aesthetic experience for the sake of it, rather than something that is necessarily situated and that must therefore confront the wider consequences of its own making.

23 Chris Csikszentmihalyi, 'Sixteen Reflective Bits', *Critical Making Zine*. Available from: http://conceptlab.com/criticalmaking/PDFs/CriticalMaking2012Hertz-Manifestos-pp23to32-Csikszentmihalyi-SixteenReflectiveBits.pdf.

A similar approach as Ushahidi is used in the project Grassroots Mapping by the Public Laboratory for Open Technology and Science (PLOTS), a project emerging from the context of the oil spill in the Gulf of Mexico. Concerned residents, scientists, and members of PLOTS worked together to collect images of the coastline before, during, and after the spill. The information gathered provided residents with the tools to discuss restoration and recovery. The project was so successful that international development NGOs like UNICEF and the World Bank have reached out to PLOTS to use this method of participatory mapmaking in other regions of the world. Here, successful technology is packaged up, ready for plug-and-play use anywhere and everywhere.

But in an article on their work so far, PLOTS members discuss the urgency for situated learning and challenging black box technology. They voice a critique of a misunderstanding about their work as exclusively technology-driven and one that fits neatly within technological determinism: 'organizations conceptualize Grassroots Mapping as primarily a set of technical practices and technologies [...] that can be passed from experts to trainees without providing time for the development of shared norms or cultural meanings around the tools'.[24] The founders stress that any repetition of the project requires challenging the black boxing of technology. This requires situating the project in the context it is meant to be applied in, enabling communities to become active participants in the project. PLOTS argue that this happens through situated learning, a learning theory developed by Jean Lave and Etienne Wenger, which stipulates that learning is practical and situated in the context it takes place in. Situated knowledge is embodied. Indeed, Haraway asserts that her essay on Situated Knowledges 'is an argument for situated and embodied knowledges and an argument against various forms of unlocatable, and so irresponsible, knowledge claims'.[25]

Ushahidi and Grassroots Mapping are important examples of projects that emerge from specific social contexts, primarily contexts of shared need for safety and security in times of crisis. These systems can also set precedents and norms for forms of interaction, responsibility, and social consciousness once the crisis has passed. Here we see examples of how these home-grown systems are able to work with the norms and regulations of the places in which they're developed to great success. These projects have grown and exist only in the context that they are applied in, and are responses to actual crisis. They present a small part of the heterogeneous array of projects that might be identified as characteristically maker movement type projects in the widest sense, but without existing in the homogenous top-down framework of the maker movement. That is not to say that learning from these projects is not transferable, but only if it is developed by situating the project properly in its new context.

24 Shannon Dosemagen, Jeffrey Warren, and Sara Wylie, 'GRASSROOTS MAPPING: Creating a participatory map-making process centered on discourse', *Journal of Aesthetics and Protest*, Issue 8. Also available from: https://www.joaap.org/issue8/GrassrootsMapping.htm.

25 Donna Haraway, 'Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective', *Feminist Studies* 14 (3) (Autumn, 1988): 575-599.

Embodied Making

Much of maker culture is founded on understandings of the human as a discrete, individual subject, which neatly translates into a neoliberal framework that requires us to dream, imagine, and make individually rather than collectively. The bodies of individual subjects fit into neoliberal economic models, in which the individual as consumer might have the power to choose, but not the power to resist or counter collectively.[26] Because of the complex sociotechnical systems we are entangled in and the planetary challenges we face, this approach is insufficient. Our entanglements and 'new relations to the natural world and to sociotechnical systems are calling these previous understandings into question'.[27]

Maker culture is more often than not anthropocentric. While there are an increasing number of examples that challenge such human centrism, these are not often found within the field of maker culture. The British designer Thomas Thwaites explored different bodies and embodiment in his project *Goat Man: How I took a Holiday from Being Human* for which he aimed to become other, in this case a goat. The project developed from questioning our observer position and attempted to challenge the idea that we can never truly change the position from which we experience the world. The artist envies the ability of animals to live in the moment, without constructing narratives of pasts and futures, a trait he defines as specifically human. Thwaites investigated becoming a goat by consulting a shaman, neuroscientists, animal behaviorists specializing in goat behavior, prosthetists, microbiologists specializing in the microbiology of the rumen (the largest of the four stomachs of a goat), and a goat herder in the Alps.

Putting these perspectives together, Thwaites then used technologies to emulate the bodies of goats. The artist went through a lengthy process of making through trial and error, working with specialists along the way. He made several iterations of exoskeletons, and then, with the help of prosthetists, he developed an exoskeleton that enabled him to become a quadruped. He developed a prosthetic rumen in order to be able to digest a diet of grass. And he spent three days with a herd of goats in the Alps, trying to live in the moment and become a goat. One of his findings, documented in his book, is that the project enabled him to think of the entanglement and complex networks that we inhabit: 'Being an animal would help us remember that there is no manifest destiny to the human species – we are just among all these other creatures'.[28]

The challenges we face require a more pluralistic approach to embodiment and the bodies we include in general. Maker culture needs to take account of this plurality and involve bodies, systems, networks, and corporeal processes, but also an understanding of a great diversity of bodies. The power of making needs to come from an inbuilt plurality in which we

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26 Laura Forlano, 'Posthumanism and Design', *She Ji: The Journal of Design, Economics, and Innovation* 3(1) (2017): 16-29.

27 Forlano, *Posthumanism and Design.*

28 Thomas Thwaites, *Goat Man: How I took a Holiday from Being Human*, Princeton: Princeton Architectural Press, 2016.

enter into conversation with nature as an active agent. There is 'an argument for the pleasure in the confusion of boundaries and responsibility in their construction',[29] which also applies to maker culture. The tactics of embodied and situated making, counter to the strategic approach of maker culture, challenge and destabilize anthropocentric epistemologies – and making plays an active part in this process.

Towards More-than-Making

The rhetoric of the maker movement speaks of transformational change to individuals, society, and culture. While this vision is dangerously appealing on a surface level, it is mostly presented from a culturally homogenous and narrow political vantage point. It does not make clear who will be excluded in this bright future, only that it is brought about by technology and innovation-driven progress with anthropocentric concerns at its core. This blinkered vision has resulted in a monoculture colonizing the idea of making and ignoring other histories, cultures, and practices – a myopic approach that overlooks any alternatives.

We have presented a number of examples of different maker practices, which are intended to actively question the possibility of forms, places, and people. Their maker credentials are not defined by their ability to master machines and manipulate materials, but are instead a product of their social and material conditions. These practices also start from a position of productive uncertainty, situatedness, and relationality to surroundings and materials. The prominent maker movement rhetoric about transformational change has not proved to foster equitable systems of mass industrial production, nor create local and socially integrated hubs with evenly distributed access. In fact, the message of individual empowerment is closest to the truth – but that individual is most commonly a neoliberal figure whose success is not judged on positive impact to the social or environmental fabric.

In this institutionalized form, maker culture has become strategic rather than tactical – shaping the actions of members within, and identifying itself against those without. Against such exclusivity, each of the alternative examples presented here frame making as a tactic, enabling different people to participate, purposefully situating making in specific contexts, and opening up making to practices that go beyond domination of the physical environment. Grassroots and strategic making is broadened to include practices that are about the incidental entanglement of materials, environments, people, and ideas. These practices are then broadened to include, for instance, community making, social movement making, homemaking, and unmaking. Such making is about creating collective subjectivities that are constructed in a process with our surrounding non-human and human counterparts.

Are we best served by conceiving of making as a singularly anthropocentric concern? What does our recent history of maker culture and contemporary conditions (social, economic, environmental) tell us about putting more things into the world based on the

29 Donna Haraway, *A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century,* http://www.medienkunstnetz.de/source-text/115/.

drives of human agency? Within our examples, more-than-human agency is an accepted or imposed condition that is not always desirable, but that always has potential. More-than-human agency challenges and complicates our relationship with the material world, encouraging a less hubristic, more attentive approach to making, and a more substantive politics of material culture.

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Making Critical Ethical Software

Caroline Sinders

MAKING CRITICAL ETHICAL SOFTWARE

CAROLINE SINDERS

Machine learning is a large and important part of product design. It's embedded in most of the everyday things that users touch, from Google search results to internet ads and Netflix recommendations. Machine learning algorithms have also been used in biased and unjust prison sentencing,[1] in facial detection (or lack thereof),[2] in biased hiring practices that favor male applicants in technical roles,[3] and in other ways that harm everyday people in everyday ways. Technology can amplify harm, bias, misogyny, racism, and white supremacy. Even if technology cannot create equality, technology as a whole needs to be examined and remade in order to create some equitable spaces.

What would it look like to create technology – an equitable technology of harm reduction and active critique – as an artistic as well as a technical intervention? Where are the intersections of machine learning with tech and with art? Tania Bruguera's concept of *Arte Útil*, or 'Useful Art', explores this notion of usefulness, of utilitarianism, in order to create an intervention that is both an artwork and a tool.

> Useful Art is a way of working with aesthetic experiences that focus on the implementation of art in society where art's function is no longer to be a space for 'signaling' problems, but the place from which to create the proposal and implementation of possible solutions. We should go back to the times when art was not something to look at in awe, but something to generate from. If it is political art, it deals with the consequences; if it deals with the consequences, I think it has to be useful art.[4]

Feminist Data Set started in 2017 as a response, from an art and critical design space, to the many documented cases of problems in technology as well as bias in machine learning. It is a critical research and art project that examines bias in machine learning through data collection, data training, neural networks, and new forms of user interface (UI), as well as an attempt to create a feminist artificial intelligence (AI). Inspired by the work of the maker movement, critical design, Arte Útil, the critical engineering manifesto, Xenofeminism, and the Feminist Principles of the Internet, *Feminist Data Set* is a multi-year project designed to counteract bias in data and machine learning.

In machine learning, data defines the algorithm: it determines what the algorithm does.

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1 Julia Angwin, Jeff Larson, Surya Mattu, and Lauren Kirchner, 'Machine Bias', *ProPublica*, 23 May 2016, https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing.

2 Adam Frucci, 'HP Face-Tracking Webcams Don't Recognise Black People', *Gizmodo*, 22 December 2009, https://www.gizmodo.com.au/2009/12/hp-face-tracking-webcams-dont-recognise-black-people/.

3 Jeffrey Dastin, 'Amazon Scraps Secret AI Recruiting Tool That Showed Bias Against Women', *Reuters*, 10 October 2018, https://www.reuters.com/article/us-amazon-com-jobs-automation-insight/amazon-scraps-secret-ai-recruiting-tool-that-showed-bias-against-women-idUSKCN1MK08G.

4 Arte Útil, http://www.arte-util.org/.

In this way, data is activated – it has a particular purpose, being as important as the code of the algorithm. But so many algorithms exist as proprietary software, as black boxes that are impossible to unpack. For instance, why does Facebook's timeline serve up certain posts at certain times by certain users? Why do you see the photos of some friends more than others? Facebook's timeline is driven by a black box algorithm designed to give you selective and 'important' content. The standards defining exactly what is 'important' are determined by Facebook and are not shared with the general public, nor are they open to public critique or feedback. How Facebook responds and processes a user's data is considered proprietary. As a user, you do not own your data, Facebook does. How Facebook chooses to feed your own data back to you is considered Facebook's proprietary content.

Data inside of software, and especially in social networks, comes from people. What someone likes, when they talk to friends, and how they use a platform is human data – it's not cold and mechanical, nor is it latent, already lying there waiting to be scooped up. Data inside of social networks is intimate data, because conversations and social interactions, be they IRL or online, are varying forms of intimacy. Who people are, what they post, what they like and dislike, how they interact with one another – all these 'things' are completely human. And those 'things' are also data.

Feminism and Technology

Feminist Data Set imagines data creation, as well as data sets and archiving, as an act of protest. At a time where so much personal data is caught and hidden by large technology companies, used for targeted advertising and algorithmic suggestions, what does it mean to make a data set about political ideology, one designed for use as protest? How can data sets come from creative spaces? How can they be communal acts and works? What would it look like for a community to make a data set about that same community? It might be a self-portrait or a protest, it might demand to be seen, it might be an intervention, a confrontation – or all of the above. It can be incredibly political.What about how a system then interprets that data? What if that system were also open to critique as well as community input?

Ethical, communal, 'hackable' design and technology is a start towards an equitable future. It allows for community input, and for a community to drive or change a decision about a product, its technical capability, and its infrastructure. Feminist Principles of the Internet, a manifesto that addresses how to build feminist technology for the internet, builds upon this ethos by recognizing that, in the process of making technical infrastructure, *who* it is built for has political ramifications. Feminist Principles of the Internet pushes open source technology and communities further by demanding space for marginalized groups and intent within technology, and it's this ethos in which *Feminist Data Set* exists.

Feminist Principles of the Internet, alongside theories like cyborg feminism and Xenofeminism, call for a change in technology and how it functions, as well as a change of leadership and ownership for that technology.



Fig. 1. Rachel Steinberg, image of the artist holding a workshop to create the data taxonomy and matrix for Feminist Data Set,*2018*.[5]

The manifesto of Feminist Principles of the Internet demands a redefinition and re-purposing of technology and open source: 'Women and queer persons have the right to code, design, adapt, and critically and sustainably use ICTs and reclaim technology as a platform for creativity and expression, as well as to challenge the cultures of sexism and discrimination in all spaces'.[6] Within this document, Feminist Principles of the Internet define 'agency' as a necessary form of empowerment. 'We call on the need to build an ethics and politics of consent into the culture, design, policies, and terms of service of internet platforms. Women's agency lies in their ability to make informed decisions on what aspects of their public or private lives to share online'.[7] *Feminist Data Set* exists within those realms of both technology and agency, as a critique on current machine learning infrastructure and practices, as well as a technical framework, critical methodology, and practice-based artwork attempting to address these issues.

Critical Design as a Medium

This reexamining of what software can and should do is similar to the creation of 'Critical Design', an initiative that addresses the limitations of product design. *Feminist Data Set* is inspired by this critical lens, taking aspects of the critical design movement but applying it to

5 Image reprinted with permission of SOHO20 gallery.

6 'Feminist Principles of the Internet v. 2.0', *Feminist Principles of the Internet*, last modified August 26, 2016, https://feministinternet.org/sites/default/files/Feminist_principles_of_the_internetv2-0.pdf.

7 'Feminist Principles of the Internet', p. 4.

machine learning. 'Critical Design' as a term was coined in 1997 by Anthony Dunne, stemming from a practice he developed with Fiona Raby when they were research fellows at the Royal College of Art. Critical Design as a practice 'is one among a growing number of approaches that aim to present and define interrogative, discursive, and experimental approaches in design practice and research'.[8] Critical design demands that design stop existing in terms of capitalist production, which is a function of product design, and push product design towards self-examination and cultural critique. Dunne and Raby argue that:

> the design profession needs to mature and find ways of operating outside the tight constraints of servicing industry. At its worst, product design simply reinforces capitalist values. Design needs to see this for what it is, just one possibility, and to develop alternative roles for itself. It needs to establish an intellectual stance of its own, or the design profession is destined to lose all intellectual credibility and [be] viewed simply as an agent of capitalism.[9]

By redefining how product design can be created, critical design also creates new ways for an audience to engage with design and understand all of the different facets of design in their daily lives.

Similarly, the maker movement helped redefine hardware engineering as a space of exploration and engagement by redefining 'engineering'. Engineering went from an expertise held by seasoned computer scientists to a method of investigation and construction that also welcomed everyday tinkerers and explorers. The growing ease and quickness of creating technology moved engineering into a space of play, and with that, into a space where anyone could create, changing what it meant to be 'an engineer'. With the advent of the small, affordable, adaptable, and easy-to-use Arduinos (microcomputers), the debut of the company Adafruit, the creation of the fair/conference Maker Faire (a gathering for maker enthusiasts), and now with LittleBits (an educational company that creates small toys that teach children about electrical engineering, a precursor to getting an Arduino), the revolution of the maker movement is similar to the citizen science movement – it's a technology-for-everyone revolution. When technology components are easy to engage with, able to be both used and remixed, they create a diversity of projects as well as a diversity of community. It's revolutionary because it creates new spaces but also allows for the examination of processes, like traditional computer science, that once existed in the 'walled garden' of the academy. When institutionalized processes are opened up, becoming open source, they are re-adapted for an entire community. These processes allow for more input, and one could argue, more equity. But that's in an ideal world – there are still plenty of issues of racism and sexism, as well as gatekeeping, inside both the open source movement and the maker movement. That being said, the ability to augment, change, remix, or 'fork' an experience, technology and code is what makes 'making' an important movement in the modern world.

Feminist Data Set operates in a similar vein to Thomas Thwaites' *Toaster Project*. In this critical

8 Matt Malpass, *Critical Design in Context: History, Theory, and Practices*, London: Bloomsbury, 2016.
9 Anthony Dunne and Fiona Raby, *Design Noir: The Secret Life of Electronic Objects*. Basel: August/ Birkhäuser, 2001.

design project, Thwaites built a commercial toaster from scratch, from melting iron ore to building circuits and creating a new plastic toaster body mold. However, *Feminist Data Set* takes a critical and artistic view of software, particularly machine learning. What does it mean to thoughtfully make machine learning, to carefully consider every angle of making, iterating, and designing? Every step of this process needs to be thoroughly re-examined through a feminist lens, and like Thwaites' toaster, every step has to actually work.

The Process of Feminist Data Set

Originally, *Feminist Data Set* started as a collaborative data set, built through a series of workshops that aimed to address bias in artificial intelligence. The iterative workshops are key; by 'slowly' gathering data in physical workshops, we allow a community to define feminism. But I also, workshop by workshop, examine what is in the data set so that I can course-correct to address bias. I viewed this as farm-to-table sustainable data set 'growing'. Are there too many works by cisgender women or white women in the data set? Then I need to address that in future, or run follow-up workshops by creating a call for non-cis women, for women of color, and for pieces of work by trans creators. In December 2018, we held a Feminist Data Set workshop in a queer bookstore to add works from queer poets, writers, artists, and community organizers to the data set.

By design, the project will eventually result in the creation of a feminist AI system. However, there are many steps involved in the process:

1. data collection
2. data structuring and data training
3. creating the data model
4. designing a specific algorithm to interpret the data
5. questioning whether a new algorithm needs to be created to be 'feminist' in its interpretation or understanding of the data and the models
6. prototyping the interface
7. refining

Every step exists to question and analyze the pipeline of creating using machine learning. Is each step feminist, is it intersectional, does any step have a bias, and how can that bias be removed?

As a way to 'design out bias', I look to The Critical Engineering Manifesto by Julian Oliver, Gordan Savičić, and Danja Vasiliev. The Critical Engineering Manifesto outlines ten principles as a guide to creating engineering projects, code, systems, and ideals. Similar to critical design, it exists to examine the role that engineering and code plays in everyday life, as well as art and creative coding projects. Principles 2 and 7 address the role of shifting technology:

> 2. The Critical Engineer raises awareness that with each technological advance our techno-political literacy is challenged [...]

> 7. The Critical Engineer observes the space between the production and consumption of technology. Acting rapidly to changes in this space, the Critical Engineer serves to expose moments of imbalance and deception.[10]

Similarly, this manifesto (as well as others) helped serve as a basis for writing the original Feminist Data Set Manifesto, created in workshop 0 of the Feminist Data Set in London's SPACE Art and Technology in October 2017.

> *The Feminist Data Set Manifesto:*
>
> OUR INITIAL INTENTION: to create a data set that provides a resource that can be used to train an AI to locate feminist and other intersectional ways of thinking across digital media distributed online.
>
> OUR INTENTIONS, in practice, over the course of two days, we created a data set that questions, examines, and explores themes of dominance. Inspired by the cyborg manifesto, our intention is to add ambivalence, and to disrupt the unities of truth/information mediated by algorithmic computation when it comes to expressing power structures in forms of domination, particularly in relationship to intersectional feminism.
>
> OUR FUTURE INTENTIONS are to create inputs for an artificial intelligence to challenge dominance by engaging in new materials and engaging with others. We are building, collaboratively, a collection.
>
> Through collaboration, we created a new way to augment intelligence and augmented intelligence systems, instead focusing on autonomous systems.
>
> OUR MAIN TERMS: disrupt, dominance
>
> MANIFESTO: we are creating a space/thing/data set/capsule/art to question dominance.

This manifesto defined the current and future intentions of the project. *Feminist Data Set* must be useful, it must disrupt and create new inputs for artificial intelligence, and it must also be a project that focuses on intersectional feminism.

To date, the project has only been gathering data. The next step in the project will be addressing data training and data collection. In machine learning, when it comes to labeling data and creating a data model for an algorithm, groups will generally use Amazon's labor force platform, Mechanical Turk, to label data. Amazon created Mechanical Turk to solve their own machine learning problem of scale. They needed large data sets trained and labeled.

10 The Critical Engineering Working Group, 'The Critical Engineering Manifesto', October 2011-2019, https://criticalengineering.org/.



Fig. 2. Caroline Sinders, The Feminist Data Set installed at the Victoria and Albert Museum, 2018.[11]

Using Mechanical Turk in machine learning projects is standard in the field; it is used everywhere from technology companies to research groups to help label data. For the *Feminist Data Set*, the question is: Is the Mechanical Turk system feminist? Is using a gig economy platform ethical, is it feminist, is it intersectional? A system that creates competition amongst laborers, that discourages a union, that pays pennies per repetitive task, and that creates nameless and hidden labor is not ethical, nor is it feminist.

In 2019, I will be building, prototyping, and imagining what an ethical mechanical turk system could look like. Created from an intersectional feminist lens, this system could be used by research groups, individuals, and maybe even companies. This system will be ethical in the sense that it will allow for more transparency in who trains and labels a data set. The trainers will also be authors, and the system will save data about the data set. This system will also give researchers or project creators the ability to see how much one trainer has trained the data, as well as invite and verify new trainers. Additionally, project creators will be able to pay trainers through this system by suggesting living wage payments. But this system also creates necessary data about the data set itself. This data about the data set includes who labeled or trained it, where are they from, when the data set was 'made' or finished, and what's in the data set (e.g. certain kinds of faces). If machine learning is going to move forward in terms of transparency and ethics, then a variety of issues – how data is trained, how trainers interact with it, and how datasets are used in algorithms and model creation – need to be critically examined as well.

11 Image courtesy of the Victoria and Albert Museum, London.

Making must be thoughtful and critical to create equity. It must be open to feedback and interpretation. We must understand the role of data creation and how systems can use, misuse, and benefit from data. Data must be seen both as something created from communities, and as a reflection of that community – data ownership is key. Data's position inside technology systems is political, it's activated, and it's intimate. For there to be equity in machine learning, every aspect of the system needs to be examined, taken apart and put back together. It needs to integrate the realities, contexts, and constraints of all different kinds of people, not just the ones who built the early Web. Technology needs to reflect those who are on the web now.

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Behind the Smart World – Artistic Remixing of a Global Data Breach

KairUs (Linda Kronman & Andreas Zingerle)

BEHIND THE SMART WORLD – ARTISTIC REMIXING OF A GLOBAL DATA BREACH

KAIRUS (LINDA KRONMAN & ANDREAS ZINGERLE)

Consumer electronics such as smartphones and notebooks have become an indispensable part of our daily lives. The Internet of Things (IoT) is adding increasing numbers of electronic devices onto our shopping list, devices that are forming a 24h surveillance system tracking every aspect of our lives. Through planned obsolescence, life cycles of many electronic products are significantly shortened, resulting in more e-waste. While some obsolete devices end up in regulated e-waste centers in Europe, 47% of European e-waste is illegally dumped in developing countries each year.[1] These devices still contain personal data that can be recovered and abused if it fell into the wrong hands.

In August 2014 we – as the artist collective KairUs – bought 22 hard-drives from the biggest West African e-waste dump (Figure 1), Agbogbloshie (Accra, Ghana). With a background in investigating cybercrime in our artworks, our initial aim was to examine how criminals can access personal information from computer hard-drives retrieved from e-waste dumps. However, the project evolved into a collaborative practice-based research lab. Together with artists and researchers, we explored what happens to our electronic waste, what kind of data traces of the drive's prior owners are revealed, and what environmental and privacy threats exist.

During the research lab we were able to recover data from six of the hard-drives. The recovered data was shared with a trusted network of artists, treated as found footage, and remixed into experimental videos and installations. These artistic experiments confirmed that personal data can easily be found, reused and abused by unknown third parties when data on the hard-drives is not encrypted, properly deleted, or the drive itself not physically destroyed. The artistic positions, interpretations and provocations were presented in several different iterations at exhibitions and media art festivals.

The study confirms the findings of literature and media scholar Matthew Kirschenbaum who argues that storage mediums collected at e-waste dumps can also become vehicles for data breaches.[2] Sociologist Jennifer Gabrys writes that our electronic waste tends to linger,[3] first forgotten in shoeboxes at home, then recycled, perhaps resold on a flea market or shipped with other discarded electronics. Hence, the afterlife of our electronics provides several opportunities for data breaches which can take place in numerous geographical locations.

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1 'Where Does E-waste End Up?', *Greenpeace,* 24 February 2009, https://www.greenpeace.org/archive-international/en/campaigns/detox/electronics/the-e-waste-problem/where-does-e-waste-end-up/.

2 Matthew Kirschenbaum, *Mechanisms: New Media and the Forensic Imagination*, Cambridge, MA: MIT Press, 2008.

3 Jennifer Gabrys, *Digital Rubbish: A Natural History of Electronics*. Ann Arbor: University of Michigan Press, 2011.



Fig. 1. KairUs collective, Buying hard-drives in Agbogbloshie, Accra, Ghana, 2014.

Artists like Michaela Lakova have worked with reanimating hard-drives from local flea markets in Romania, while artist Raphael Perret has made extensive work aimed at raising awareness of the working conditions of Indian e-waste recyclers.

The *Behind the Smart World* project describes how our consumer electronics leave long-lasting environmental and digital traces, emphasizing how material our digital life is. Moreover, we want to describe one model of a process oriented, artistic research lab that has evolved through an evolving assembly of artists and researchers.

Information Diving in West Africa

Driven by the constant technological innovations of consumer electronics and the shorter life-cycles of smart devices, consumers produce an increasing amount of e-waste each year. If these obsolete gadgets are not properly recycled, sensitive information and personal data can still be found on the devices:

> Some people will not wipe their hard-drives and obviously if you dispose of that computer it can be accessed by criminals [...] The problem is many of them don't know where they're ending up.[4]

4 Josie Ensor and Richard Gray, 'How Your Old Computer May Be on Its Way to Africa's Online Fraud Capital', *The Telegraph*, 25 November 2012, http://www.telegraph.co.uk/news/earth/earthnews/9700836/How-your-old-computer-may-be-on-its-way-to-Africas-online-fraud-capital.html.



Fig. 2. KairUs collective, Agbogbloshie electronic waste dump, one of the most toxic places on earth, 2014.

In the recycling process, our abandoned electronics go through many vendors who can easily access and exploit our data. Even when exporting e-waste is regulated by the Basel Convention regarding *Control of Transboundary Movements of Hazardous Wastes and Their Disposal*,[5] traders use loopholes like labeling non-functional consumer goods as 'second hand' and 'third world help', conveying the intention of helping to bridge the digital divide. An investigative journalist team from Germany tracked the route of two TV sets equipped with GPS devices from a German buyback center to the street markets in Nigeria and the Agbogbloshie e-waste dump in Ghana.[6] Examples like this make it clear that we do not have control over what happens to our obsolete hardware. Few of us have the technical skills to properly delete data and make sure that it is unrecoverable.

In August 2014, we visited one of the biggest and most toxic electronic waste dump sites in the world, Agbogbloshie in Accra, the capital of Ghana (Figure 2). Here, people try to reuse, repair, or recycle functioning components. However, due the lack of technical equipment, the recycling process is very limited and hence very toxic for the workers and the environment. Almost all electronics at the dump had reached their end-of-life state. By dismantling the devices, functioning components were collected in order to be resold in bulk.[7] Leftover parts landed on the ground, and from this precious dirt, scavengers tried to handpick and extract valuable metals like copper, gold, silver or aluminum.

5 Katharina Kummer Peiry, 'Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal', 1989, http://legal.un.org/avl/ha/bcctmhwd/bcctmhwd.html.

6 Carolyn Braun, Felix Rohrbeck, Christian Pfeil, and Christian Salewski. 'Die GPS-Jagd! Was Passiert mit Unserem Schrott?', 2015, *Arte,* http://infographic.arte.tv/future/follow-the-money/de/.

7 Martin Oteng-Ababio, George Owusu and Mary Chama, 'Intelligent Enterprise: Wasting, Valuing and Re-valuing Waste eEectrical and Electronic Equipment', *The Geographical Journal* 182, no. 3 (2016): pp. 265-275.



Fig. 3. KairUs collective, Extraction of hard-drives from laptops, 2014.

Besides this physical separation of e-waste, recycling components and metals, we learned that sensitive information on old hard-drives is abused by exploiting and harassing pre-owners of these storage devices.[8] We were curious to see if it was actually possible to recover data from discarded hard-drives. To try this out, we talked to different recyclers (Figure 3) who were dismantling devices and acquired 22 hard-drives, with varying storage capacities, produced across a range of years by different manufacturers.

Initiating the AMRO Research Lab: Behind the Smart World

Back in Europe we teamed up with the Linz-based internet culture initiative servus.at, who also organizes the biennial art festival Art Meets Radical Openness (AMRO).[9] Together we started the AMRO Research Lab *Behind the Smart World*,[10] which would serve as an incubator between festival editions where artist groups are provided with resources for their research and artistic production. Through the lab we wanted to apply artistic research methodologies to investigate the following research questions:

- Would these hard-drives contain personal data that can be potentially exploited?
- What kinds of questions arise in terms of privacy and ownership of the recovered data?
- What ethical issues are participants confronted with when treating the data as found footage material for artistic production?

8 Jason Warner, 'Understanding Cyber-Crime in Ghana: A View from Below', *International Journal of Cyber Criminology* 5, no. 1 (2011): pp. 736.

9 Servus.at, https://core.servus.at/.

10 'Exhibition: "Behind the Smart World – Saving, Deleting, Resurfacing data"', Radical Openness Research Blogs, 13 March 2016, http://research.radical-openness.org/2015/.

Inspired by the open source movement and remix culture, where source material is often reappropriated by various users in different ways, the plan was to recover data from the hard-drives and redistribute it within a trusted network of artists, inviting them as co-researchers and contributors to produce artworks. To realize this goal, an interdisciplinary group of artists were invited to the *Behind the Smart World ArtLab*.

Remixing of a Global Data Breach

The concept of remixing and recycling ideas and content that others have produced has a long cultural tradition. Artists from various backgrounds use these strategies in their creative process: from experimental and found footage filmmakers, to VJing culture and circuit-bending sound artists who hack electronic toys to create sound generators and effect synthesizers. Street artists and media activists remix commercial or political advertisements towards culture jamming practices and other forms of guerrilla communication. The convergence of media, the creation of Creative Commons licensing, and the emergence of Web 2.0 platforms enable artists to collaboratively edit, remix and share content, and to critically engage with popular culture by revealing social engineering, endemic racism, sexism, and homophobia.[11,12]

Analyzing, reusing or recycling material that others have discarded can also reveal personal aspects about a person's life. This social engineering practice of 'information diving' is a search for identifiable information, with the aim of collecting sensitive information about a company or an individual. These reuse and reappropriation practices provided the context for using the hard-drive data as material for artistic productions.

The first step to providing artists with this data was to 'reanimate' it in order to make it accessible. In our initial attempt, all the hard-drives were hooked up to a PC and it was immediately possible to access some data from five of the hard-drives. After this, we tried to recover deleted data by using open source software tools. In addition to our own efforts, we also employed a data-recovery company to assist us in recovering data from one more hard-drive. In total, approximately 85 GB of personal data were recovered from six hard-drives.

During the recovery process, we contacted a number of artists who expressed interest in becoming co-researchers in the project, and we provided them with the recovered data. Aiming for a diverse mix of emerging artists, we selected six European artists who worked across various mediums: sculpture, sound, video-art, performance, and installation. We also invited Austrian artists and students from the University of Art and Design Linz. In hindsight, one shortcoming was that no artists from countries affected by illegal

11 Anders Fagerjord, 'After convergence: YouTube and remix culture', in Jeremy Hunsinger, Lisbeth Klastrup and Matthew M Allen (eds) *The International Handbook of Internet Research*, Dordrecht, New York: Springer, 2009.

12 Eli Horwatt, 'A Taxonomy of Digital Video Remixing: Contemporary Found Footage Practice on the Internet', in Iain Smith (ed.) *Cultural Borrowings: Appropriation, Reworking, Transformation*, 2009, pp. 76-91.

dumping of e-waste were included in the ArtLab, which would have enabled a more diverse approach to the problem. The overall project grew through various opportunities, our funding framework, and our own personal resources. These naturally restricted the scope, and the overall project can therefore be considered quite Eurocentric. However, the main objective was to discuss the after-effects of our Western consumer electronics culture, and we believe our chosen approach contributes meaningfully to this discourse.

ArtLab

Over an extended weekend, eight international and four Austrian artists gathered for the *ArtLab* in Linz. The first evening kicked off with the symposium and talks from the invited experts, including data broker researcher Fieke Jansen (Tactical Tech Collective), data recovery specialist Can Sintiras (ECS Global) and data forensic expert Prof. Michael Sonntag (Johannes Kepler Universität). After the talks we gave detailed insights into our own research and the data acquisition process of the hard-drives. These were followed by presentations from the artists, who each outlined their interests and concerns while analyzing the data. Furthermore, a visit to an e-waste recycling center (Figure 4) unveiled how e-waste is handled in Europe, using heavy machinery, considering health and security standards, and applying strategies against illegal e-waste trade. Group discussions with an emphasis on personal and collaborative research questions were followed by hands-on experiments such as visualizing data through sonification, microscopic photo scans of hard-drive parts, and attempts to reverse-engineer the contact details of prior owners.



Fig. 4. KairUs collective, Visiting e-waste recycle plant Müller Guttenbrunn Group, 2014.

Presenting Outcomes of Artistic Research

For a deeper insight we initiated a conversation amongst a wider group of artists concerning their research-led practice working with data, which we published in the book: *Behind the Smart World – saving, deleting and resurfacing data*.[13] Each book section is introduced by a theoretical text, which provides an overview and raises specific concerns, followed by artistic and activist strategies that expose hegemonic power structures, creatively revealing how we might deal with our data in today's 'smart world'.

For the biennial AMRO festival exhibition, selected participants from the ArtLab and the book publication presented their artworks. The exhibition was curated through network meetings and an open call.[14] Throughout the festival, artists organized guided exhibition tours, while a series of workshops and performances completed the program. In the following paragraphs we focus on several of the artworks that deal with the recovered data.

Martin Reiche's artwork *Shell Performance* (Figure 6a) is heavily influenced by data from the recovered hard-drives. The installation sifts through the masses of personal files from the unidentified previous owners and transforms them into an ASCII art-inspired digital collage that focuses on audio files, documents, images and videos. In cycling through these files, the artwork highlights our personal relationship to data and the devices it is stored on, provoking critical questions around consumerism, privacy, and digital and electronic waste management.

Video artist Fabian Kühfuß produced a found footage collage from the browsing history of one hard-drive called *Shopimation* (Figure 6b). He arranged patterns of fashion and lifestyle thumbnails in sync with a catchy song he found on the hard-drives music library, creating a choreographed animation of the pre-owner's aesthetic dreams. If, as Flusser argues, the techno-imagination is an approach of coding a function of the meaning of techno-pictures,[15] *Shopimation* uses those thumbnails to build up the subjective code of an aesthetic. In doing so, the artwork transcodes the very private dreams and desires of the drive's prior owner, visualizing who they would like to be.

We (KairUs) created a trilogy of artworks called *Forensic Fantasies* (Figure 7), a series dealing with data breaches of private information. The first artwork is called *Not a Blackmail* (Figure 7a) and explores the possibility of extorting the hard-drive's prior owner. Besides finding sensitive information about the owner, it is crucial to be able to contact them in order to make one's demands. Rather than blackmailing the person, we became curious whether it was possible to contact them. Therefore, we exhibited a ready-to-be-posted package, containing the recovered data that we want to return, along with a letter directed to the address of the prior owner.

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13 Linda Kronman and Andreas Zingerle (eds), *Behind the Smart World – saving, deleting and resurfacing data*, Linz: servus.at, 2016, Also available at: http://publications.servus.at/2016-Behind_the_Smart_World/.
14 Behind the Smart World exhibition, http://kairus.org/amro-art-meets-radical-openness-2016/.
15 Vilém Flusser, 'Towards a theory of techno-imagination', *Philosophy of photography* 2, no. 2 (2012), pp. 195-201.







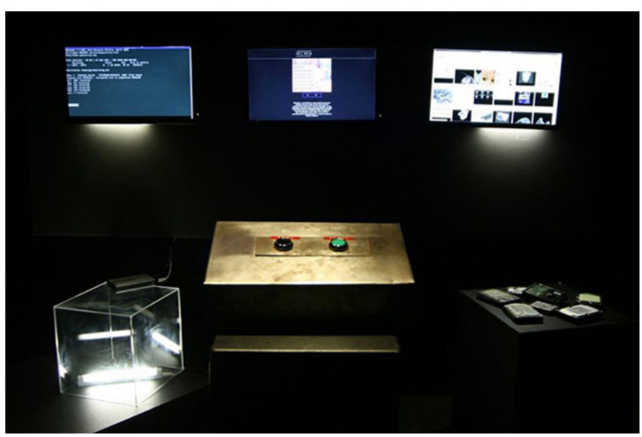


Fig. 5. KairUs collective, The Behind the Smart World *exhibition at AMRO, 2016.*
Fig. 6a. Martin Reiche, Shell performance, *program code, 2016.*
Fig. 6b. Fabian Kühfuß, Shopimation, *video work, 2016.*
Fig 6c. Michaela Lakova, DEL?No,wait!REW, *program code, 2016.*[16]

16 Reprinted with permission of the artists.

The second artwork, *Identity theft* (Figure 7b), focuses on the phenomena of romance scamming. Based on previous research into online fraud, we suspect that recovered images were used to create fraudulent profiles for future romance scamming. In this installation, 18 of the fraudulent online profiles using the same images found on the hard-drive are combined with clips of popular Nollywood found footage that cover the topic of romance scams from a West African pop-culture perspective.

The third artwork, *Found Footage Stalker* (Figure 7c), takes a closer look at the private images found on one of the hard-drives. Over a number of years, we gain highly personal insights into the lifestyle of the prior owner, following them to wild parties with friends, trips to amusement parks, and private Christmas celebrations with their family. Flipping through the images provokes a similar feeling to stalking a stranger on social media. Despite the rather uninteresting photo material, one starts to create stories and attach a personality to these fragmented digital representations. By presenting them in a classic photo album, we approach the material as found footage, ready for remixing and creating new artworks. By excavating personal data from amongst the trash, the artwork intersects with earlier artistic practices of remixing and reappropriation.

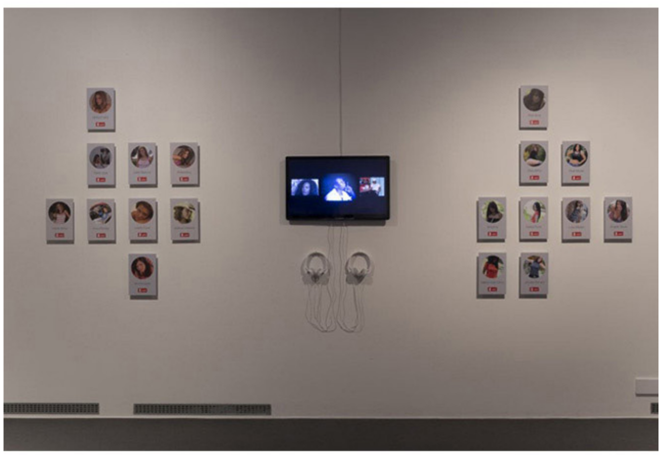
Michaela Lakova's installation *DEL?No, wait!REW* (Figure 6c) constantly recovers files from one hard-drive and presents them to the viewer. The installation aims to prompt viewers with an ethical choice: save the file by publishing it online or deleting it. The published images are displayed on the artist's website, while the deleted files will be recovered again, saved once more, only to face the decisions of future users. For the AMRO exhibition Lakovas installation was using data from our hard-drives.

Behind the Smart World linked data breaches with electronic waste by exploring how data is collected, recorded, stored, and erased, resurfacing in unexpected ways. During the Research Lab it became evident that our hard drives and other storage mediums are intertwined in complex techno-ecologies. With a group of artists from the *Behind the Smart World* network, we continued collaborating, creating an interactive world-map. *Mapping the Smart World* examines the life-cycles of consumer electronics and network technologies, beginning from mineral mining, through to refining elements, producing metal alloys, magnets, and other components, and finally assembling consumer goods in our 'smart world'. Along with this supply chain mapping, the project maps the data centers that hold a key position in our everyday device use. At the end of this life-cycle, electronic waste once again becomes a source of raw materials such as metals and plastic. This map provides a framework for the future exploration of research topics.

On opposite page:
Fig. 7a. KairUs, Not a Blackmail (Forensic Fantasies trilogy), *Mixed media, 2016;*
Fig 7b. KairUs, Identity theft (Forensic Fantasies trilogy), *Mixed media, 2016;*
Fig 7c.Kairus, Found Footage Stalker (Forensic Fantasies trilogy), *photo series, 2016. All photos by Janez Janša.*[17]

17 Reprinted with permission of the photographer.






Weekends

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Getting Lost and Unlearning Certainty: Material Encounters in an Electronic Craft Practice

David Cole &
Hannah Perner-Wilson

GETTING LOST AND UNLEARNING CERTAINTY: MATERIAL ENCOUNTERS IN AN ELECTRONIC CRAFT PRACTICE

DAVID COLE AND HANNAH PERNER-WILSON

Although Hannah is a maker/artist/engineer and David an educator/learning designer/writer, we both work in the same realm of DIY craft technology involving electronics, and consider ourselves to have a material practice. By 'material practice' we mean a process (time and energy spent) of interacting with tangible materials – both to construct and share knowledge about the world, and to express and share our ideas with the world. The material nature of our textile and paper electronics practices – thinking of electronics in terms of materials – is a necessary part of our craft which we see as standing in contrast to other common DIY ways of building and learning about electronics, which are very much shaped by a *kit-of-parts approach* and a *workmanship of certainty*.

Together we reflect how a *workmanship of risk,* and a more connective tactic or *kit-of-no-parts* approach to building electronics can create transformative dialogues with materials and each other. As a means of preparation for this piece, we engaged in a 6-week handwritten letter exchange – a distinctly material practice these days – during which we wrote to each other in order to expose the role of materials in our respective processes.

Electronic Textiles Meets Paper Engineering with Electronics

Hannah: I spend my days crafting electronic textiles, imagining what this technology, worn on our bodies, will allow us to sense, to communicate, to become. As an explorer of new materials, I create soft circuits and textile sensors that I document and share on How To Get What You Want[1] and A-Kit-Of-No-Parts[2], hoping to inspire others to join me in this material practice. The idea of a no-parts-kit represents a challenge. What could be the opposite of an *of-parts* approach to making, collaborating and sharing? In a Kit-of-Parts approach, functionality is compartmentalized into discrete building blocks and an overarching system describes how these blocks are able to interact with one another. This enables people to collaborate in creating and sharing blocks for the same system, and potentially allows a building process with these blocks to be less energy intense because much of the connection work is already solved by the system. Much of our experience with the materials of electronics is informed by this approach. Alternative ways of making, collaborating, and sharing get overlooked because of its dominance. Thus with a Kit-of-No-Parts I want to draw attention to this fact, and challenge myself and others to explore other ways of making, collaborating, and sharing. These observations are very much informed by my experience working with e-textiles, where I blend practices of craft and engineering, bringing together old textile techniques with new material technologies.

Starting points for my work vary from open-ended playful explorations of materials/tools/techniques in order to discover interesting narratives and diverse ways of doing things (such as hand-embroidering elaborate circuitry onto a funeral gown to speak about possible futures), to directed commissions looking to problem-solve and realize concrete ideas (such as developing robust hard-soft connections, insulation methods, sensor and actuator designs).

1 Hannah Perner-Wilson, *How To Get What You Want,* http://www.howtogetwhatyouwant.at.

2 Hannah Perner-Wilson, 'Kit-Of-No-Parts: Recipes for Materially Diverse, Functionally Transparent and Expressive Electronics', *Plusea,* http://konp.plusea.at/.

Whether I'm exploring or solving, I find myself seeking direct, hands-on encounters with the materials of electronics – materials that due to their abilities to conduct, resist, isolate, store, or generate electrical current are able to make up what we think of as electronics. I'm drawn to this more interactive style of dialogue because it allows me to engage more of my bodily sensors (sensations) and actuators in real-time debate-like conversation. There is this image of future technology being fully constructed by machine and a workmanship of certainty. I'm drawn to exploring the other end of the spectrum, towards what furniture designer and design theorist David Pye's describes as the *workmanship of risk*.[3] How uncertain, how intimate, how messy, how physically and collaboratively connected can we get with the materials of electronics?

David: I remember the moment after completing a degree in literature when I decided I would turn to boatbuilding as a way to engage with a tradition and body of work where the materials would not talk to me. Language, theme, story, critique, and the craft of argument that I had been focused on created worlds and felt, as social, narrative, textual projects, uniquely negotiable; the forms, tools, techniques, and materials in boatbuilding did not. I was interested in understanding what learning and attention felt like in relation to physical things. After that I spent several years moving between boat work and teaching, between wood and words, which was, I've understood, an effort at finding a kind of balance for how I engage with the world.

I'm an educator and writer by training who works with technology, curriculum, and teacher professional development. I work in- and out-of-schools with projects and learner communities that focus on literacy, college and career-readiness, and the use of technology via platforms, tools, and interest-driven, production-centered work in which learners develop and share their ideas through artifacts, projects, and collaborations. In the last five years I've focused on creative learning with paper and electronics, which has been, very clearly, a return to that initial impulse to blend fast and slow, to understand relational ways of seeing and thinking as complementary and connected to physical things we make.

I was familiar with Hannah's work through Leah Buechley's High-Low Tech group at MIT. I was struck by the ways in which she was opening up electronic components and systems, treating them as material, and being deeply mindful about recording what she was doing. The breadth of her documentation and her transparency with process and materials seemed to be much more than a supporting aspect to her work. It appeared to be absolutely central to what she was doing, perhaps even a singular objective. It was also exciting to see how the formats she uses for documentation are designed as open invitations for others to join in the work.

The work I do treats paper – the trusted format of the engineer's notebook or the artist's journal – as the platform and foundational material on which one builds small electronics projects and annotates and decorates those constructions. It's a personal, sequential story of learning that's about reflection and self-expression. It's also meant to be shared as a record of how we assemble our ideas and our materials. It's this affinity around materials and documentation that set our dialogue in motion. To this day our conversations continue to unfold without having met one another in real life.

Getting Lost by Following Materials - Hannah's Practice

As somebody who spends as much time with materials as with people, I recognize my own experience in the current discussion of a material turn in the humanities – our societies' growing recognition of the material influence on our constructions of reality. My relationship with the textiles and electronics that I've spent the last ten plus years of my life with have gotten me

3 David Pye, *The Nature and Art of Workmanship*, London: Studio Vistas, 1971.

wondering about the extent to which my world is shaped by the materials and tools that I work with. Over the last year or two this wondering has grown from a vague awareness into a quite substantial urge to understand better the extent and qualities of this influence on my making. By reflecting on our practices through the letter exchange with David, four things stand out to me as insights that I'd never before seen this clearly:

1. I'm following most of the time;
2. Materials contain the stories we use them to tell – and we think the stories are ours!
3. I'm not as skilled as I thought at smoothly transitioning between the abstract and the tangible;
4. My idea of 'getting lost with the materials' is not about engaging in an extreme material-lead adventure as much as it is departing from social frameworks of value.

Journeying with Thermochromic Pigment

During the 6 week period that David and I were corresponding, I was amid a material-lead adventure exploring thermochromic pigment, which I have attempted to capture in word and image in figure 1 and 2.

Following Materials

Contrary to popular belief (and Rule #8 of art educator Corita Kent's Immaculate Heart College Art Department Rules[4]), I would argue that creating and analyzing are not necessarily different processes that need to be separated. Selecting, collecting, choice, and decision are not independent actions but rather the result of situations with many other 'actors' involved. If one takes the time, one can embark on an endless unpacking of underlying motives/motivations/reasons/intuitions/tendencies. Even just unpacking a few layers deep, I got a sense for the vastness, intricacies, and interdependencies packed up in every decision – decisions that I don't make, but am a part of negotiating. My conditioning to perceive myself as an individual capable of achieving objectivity through analytical thinking keeps me constantly striving to untangle myself from these intricacies, although I recognize this impossibility, and would like to entangle myself further.

My histories draw me towards one thing over another. I began to use the word *interesting* in the sense of its origin to be between (combining *inter* as 'between' + *esse* as 'be' = to be between) very purposely in order to capture my sense of wanting to get closer, deeper, further into something without being able to better articulate why. An expression of interest became a recognition of my entanglement in a complex system which I could influence by channeling my energies. To invent came to mean to direct my energy to excavate where my interests lie, to uncover what is already there, rather than to 'make something out of nothing'.

Thus to be a good maker is to be a good listener/observer/sensor, and as I paid more attention to myself, not as a leader but as a follower of materials, I saw some strikingly obvious connections between the properties of the materials I was working with and the concepts (the stories, the applications) that emerge from working with them.

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4 Jan Stewart and Corita Kent, 'Immaculate Heart College Art Department Rules' in *Learning by Heart: Teachings to Free the Creative Spirit,* 2nd edition, New York: Allworth Press, 2008: p. 176.

Where Stories Come From, Material Properties are Concepts

With my newfound appreciation of material's equal role in *our* making, I began to see clear connections between a material's property (its abilities to afford our interactions/experiences with/of the world) and the conceptual narratives we so often claim as the result of our ability to abstract the physicality of these materials and claim them as our own thoughts. As Donna Haraway has put it, '*it matters what matters we use to think other matters with'*.[5] Two such material-property concepts I experienced emerging from my material encounters were CHANGE and CONTROL.

Thermochromic pigment: micro-encapsulated liquid crystals reorientate to produce an apparent change of color based on outside influence of temperature. They are the matter that is changing, but I am the one perceiving change and thus thinking of change: change in color, change in temperature, change as reaction, change is action, change reveals... What does it reveal? What triggers the change in temperature? If nothing changes would anything happen? If nothing happens, can anything change?

Conductive thread: continuous filaments of copper spun with a synthetic core are able to conduct electricity while being flexible and durable enough to travel distances, to survive being sewn, worn, and washed. By channeling the flow of electricity I am able to create and direct heat, to control it from afar. But there is also the heat of my body that I can not control. How to combine these two sources of heat so that only in combination is there control. And how to use this shared control to reveal a different perspective within the system?

The two paragraphs above are an attempt to capture the conversations that happen between the materials and myself. This is how I go about developing projects and channel energy in the system, by discovering 'stories'. Mika Anusas and Tim Ingold speak to this in their piece 'The Charge Against Electricity' when they write, 'the prosecution draws our attention to four key entailments of electrification. These are remoteness, conduction, insulation, and sensorial subtlety'.[6] In this sense I view CHANGE and CONTROL as entailments of thermochromism and electrical conductivity which together lead me – via notions of revealing, remote control, and power – to experience a questioning origins of agency.

Transitioning Between Abstract and Tangible

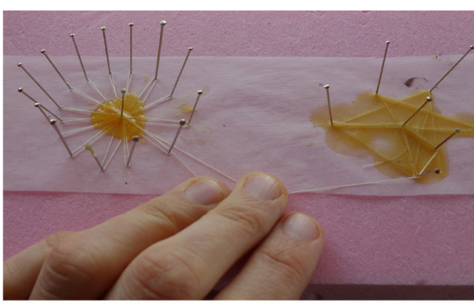
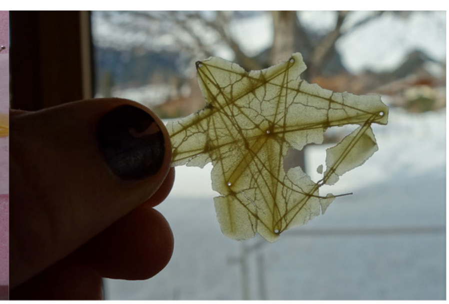
I like to think of 'thinking' as abstract (immaterial) making, and 'making' as tangible (material) thinking. We humans are constantly exerting ourselves in order for information to flow between these two forms of activity. There is much friction here and I experience getting stuck on one side or the other. But one also develops ways of overcoming the friction – running in circles to warm up, to build up the energy, to make the jump – literally taking the tools in my hands and making something I've done before to remind myself and ease the way for information to flow from my mind into my hands. Caught up on one side of the action, the other can soon appear menial. Transitions require leaps of faith and bursts of energy, both in oneself and in the material. Decision-making becomes transitioning, not only *through* but also *in* the body – in this collaboration between the analytical mind and the gut feeling.

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5 Donna Haraway, *Staying with the Trouble: Making Kin in the Chthulucene*, lecture at the San Francisco Art Institute, April 25, 2017, https://youtu.be/GrYA7sMQaBQ.

6 Mike Anusas and Tim Ingold, 'The Charge Against Electricity', *Cultural Anthropology*, vol. 30, no. 4, 2015: pp. 540-554. https://journal.culanth.org/index.php/ca/article/view/ca30.4.03/200.

*</*March-April 2019::::: I found myself unpacking a 20g bag of thermochromic pigment that changes from black to white at 36°C. Placing it in the center of my empty worktable and thinking: What can I mix it with? What can I apply it to? ----------------- Rummage through my working room, the kitchen, basically the whole house, and pull out a selection of materials that felt suitable. //As soon as I looked at the selection of materials, I see that my choices reveal things I'd not been consciously aware of while picking them. The table is full of flat, lightweight materials of natural and technological origins. From prior experience <I knew> that the more dense the material the more power it took to heat and the longer it took to cool down again. +// Every time I make a decision, I'm revealing underlying motivations, intuitions, expectations that can be uncovered if I only take the time to reflect. ---------------- Reduced my selection back to 3-4 items to help myself focus on some concrete experiments.++//There is a gap between thinking-about-making and making. It requires energy to make the jump. Energy in the form of courage, hope, stamina. //How to make the jump when the energy is not there? >>>>>>>>>>>>> Going through familiar motions*








with the most obvious of opportunities. Mixing the pigment with acrylic paint, textile paint…… painting it on fabrics, papers, seashells, pine needles, transistors…. >>>>>>>>>>>>> Hooking up the ends of a 20cm piece of steel thread to a 9V battery and using it to heat the what I had prepared. Swiping it across my samples and observing them change colour. +++//By simply doing something with the materials I had set myself up for discovering something interesting [origin of word interesting: from inter- 'between' + esse 'be' - to be between] that could then lead me further in. |<<<One tends towards familiar ground when entering new landscapes" "First discoveries that excite... "(quotes from letter, 1/3/2019)>>>|<<<"Submerge myself in the process" (quote from letter, 1/3/2019)>>>|------------ Thin, porous fabrics coated in the thermochromic mixm, held up to my noise/mouth, breathing out causes heat to spread, breathing in sucks cold air though the material. ++++//This interplay of bodily heat and electronic heat drew me in…. ------------------------------ Once submerged in the process, it was easy to keep meandering…. one idea leads to the next to the next… until I had lost track of what the point was. It was here that i made some of my most surprising and motivating discoveries >>>>>> Continuing to mix the pigment with

vaseline, nail varnish, water…… and finally wax. I never would have thought that the pigment would mix so well with wax! And that I would return to my childhood enthusiasm for poking my fingers into melting candles, dripping it on snow and making thermochromic candles. I used snow to make moulds, bringing in the outdoors, seasonal materials, adding lines of thread for composite flexibility and surface coverage…. +++++// Experiments in creating surface heating with carbon paint were not successful. --------------------- ((((Wanting to be submerged, lost, aimless…. but also needing to feel comfortable in this state. grappling for what I had experience with.)))) +++++++//What I found most intriguing was the interplay between the electrically controllable heating and the bodily (uncontrollable) heating and cooling caused by breathing as well as the heat from regular body temperature. I wanted to achieve a setup that would allow for these two different sources of heat to meet through the material actuation in order to reveal something that would otherwise not occur. ----------->>>>>>>>_______I am able to electrically change the colour of the thermochromic wax mix by embedding lines of steel thread (10-20 Ohm and can withstand high temp) in the wax, crimping their ends to copper threads, powering them from a 3.7V LiPo battery. Controlling the heating via a MOSFET triggered by a microcontroller. Controlling the microcontroller with a sensor. Controlling the sensor with my body heat._______<<<<<<<<---------- ::: Combining wax with threads resulted in a rigid yet fragile structures that could hold their form while retaining some flexibility. Since the circuitry was also comprised of connected threads it should also become such an integral part of the structure. Since the wax became soft with the same heat that was intended to change the colour the shape could shift, and I would love to to collapse. ::: Pressing my face into the fold snow and then dripping molten thermochromic beeswax onto the cold snow mound. I was making a mask, a object to use to tell <my_story> of change and control. */>

Fig. 1. (previous pages) Hannah Perner-Wilson, 'getting lost' with thermochromic pigment captured in image and text, 2019.

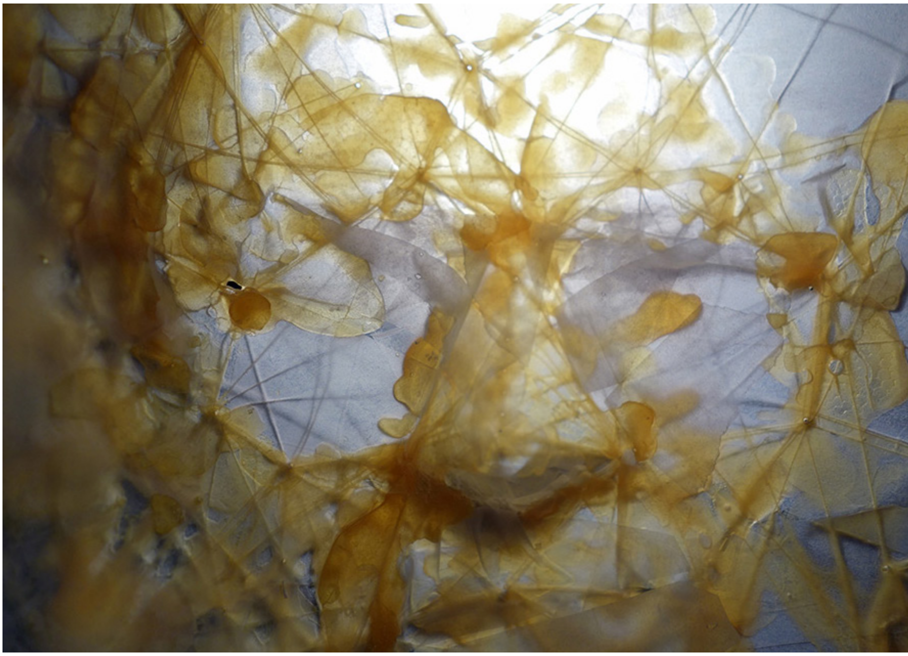


Fig. 2. Hannah Perner-Wilson, thermochromic pigment, wax and threads on translucent paper, 2019[7].

Getting Lost – the Value of Community

Initially, I really thought that all my talk of 'getting lost' was about departing on an adventure, venturing out with new materials into new terrain in order to discover new ideas. But now I would say that getting lost is not about wandering around in a new environment, it is a departing from one's established environment. There is no new environment to enter; an environment is always a constructed situation in which one exists. Leaving that environment is the challenge, or rather becoming unfamiliar with it in order to experience it anew. This requires getting lost in the process, losing one's frames of reference. Scary, but desirable, as this ability can lead one to *renewed* perspectives (not necessarily new ones) on one's relations with other/things. In his book on flow theory, Mihaly Csíkszentmihályi refers to a similar process of assimilating what one experiences during *flow* as the value of the experience on one's formation of self.[8]

The ability of community to provide trust and confidence to venture outside established frameworks of sense-making is important here. Having the letter-writing as a process of communicating with another human being was a huge grounding experience. I'm not sure if David realized how much he was helping me, possibly even guiding me through this part of my adventure. I see this very clearly now as the role of community in any process. To provide a grounding framework with which we can sustain our making endeavors. It is the presence of peers and the feeling of community and shared practice and processes that provides us with the necessary resources to keep going and navigate the unknown with enough confidence to play, dare, and explore.

7 See also: https://youtu.be/Tu36vtVU6FA.

8 Mihaly Csikszentmihalyi, *Flow: The Psychology of Optimal Experience*, New York: Harper Perennial, 1991.

Unlearning Certainty Through Familiar Rituals - David's Practice

In one of our letter exchanges, I wrote this snippet to Hannah: 'To find a way in. To take another step. To move towards something even when one doesn't know what it is or can be. And to believe it will be something [...]'. We were writing back and forth on the intuitive, intentional way we bump around in the dark, finding clues to treasure hunts of our own making. It's very much a workmanship of risk, this idea that shape, purpose, and understanding emerge from an incremental, accretive process, which begins in a bumper car space where things collide energetically, by design.

I organize my projects around communication, documentation, narrative, and storytelling. I do most of my work with paper and electronics with teachers and with learners who have not had any exposure to making or invention work. In this regard, my interest is non-technical and very much about creating conditions for going deeper with a question or following a thread of interest or inspiration. Design thinkers frame aspects of this idea with the *How Might We...* prompt. Technical teams sometimes reference the approach as building 'creative confidence'. The language of innovation and iteration – fail early, fail often, have faith in your ideas, see them through – applies here, but often it's aligned with directed problem-solving or the rhetoric of success-making. This sometimes supersedes or co-opts what I want to focus on: the nuanced experiences with doubt, persistence, curiosity, and motivation that we each live with and work through in small, important ways when doing this kind of work.

I use a limited set of materials and rely on familiar rituals and active routines associated with writing, annotating, sketching, drawing, and assembling to create the framework for a learning experience. I work mostly with program coordinators, with students and educators in the middle grades, kids aged 10 to 14 and their teachers. I've watched, again and again, how learners of all ages jump right in, not shying away from or pre-judging the components or technical aspects in the projects, because their workspace – the paper, the notebook – is so familiar. The hybrid constructions they create are evocative, personal expressions of a multi-modal literacy that remixes the old and the new, blending traditions in documentation practice and craft techniques with the affordances in new, technical materials to extend their ideas.

This work sits at the center of a Venn Diagram composed of process, tools, and community. Thinking about projects as sequential exercises, I've found I can arrange these terms in whatever order and benefit from the cumulative effect that results from considering each of the categories separately and together as they amplify in the progression from one to the next. The through-line in this triplet is always the materials. It's a reminder for me that material encounters are inseparable from the circumstances and applied context in which they're unfolding.

Appropriate Tooling and Materials

In the spring of 2019 I was working on an ongoing prototyping project, Open Data/Open Minds (ODOM), exploring papercraft as a GUI or display for data. I have had help in this project from Natalie Freed, a crafter, artist, computer scientist, and teacher who is exceptionally skilled with interfaces between physical materials (craft objects, books, paper, textiles) and computation.[9] Natalie has been a longtime partner in the ODOM work, helping to develop a string of iterative prototypes and demonstration projects that connect paper and the web.

9 See also Natalie Freed's website, http://www.nataliefreed.com/.

Together we were preparing for a workshop with the Providence Public Library's Data Navigators program,[10] a semester-long elective for high school students on the basics of Tableau, the enterprise data visualization platform. Natalie and I would travel to Rhode Island for a day of activities to introduce the basics of paper circuitry and visual block programming using the Chibi Chip by Chibitronics as an alternative and introductory way to visualize abstract information. We were working on learning routines, interfaces, and technical challenges that go with parsing data sets and pulling internet signals onto paper so information can be 'read' using an output like an LED or a servo.

This work in Providence, supported by the Civic Switchboard project[11], a consortium focused on libraries and local civic data ecosystems, would be a learning experience in 'low-resolution data' – meaning single data points or observations drawn from research and rendered on paper with light, in a simple material presentation, as a complement to the computational breadth and depth available in a data visualization on screen.

Connections between people and organizations, and the circumstances that invite and sustain collaborations, create something nearly as tangible as physical materials: trust. We constantly take steps forward together, not knowing exactly what will come of it, and put things into the world. This way of thinking sees an arrangement of materials, an object one can take pride in, as revealing a next step. Being able to imagine what might come next always feels to me like an expression of agency and capacity. In retrospect, the process unfolds like a story. I share with Hannah the idea that materials can be narrative, and that narrative and the objects we create are iterative examples of questions and ideas becoming, for a moment, tangible demonstrations of confidence and conviction, the result of a dialogue between people and materials.

Because I'm involved in education, my work is socially situated. I see making, the resurgence of hands-on learning, and the rituals and traditions it's based upon, as an equity project, which means I'm thinking about individuals' experiences in relation to the organizations and environments in which they're learning. This point of view emerged in our conversations in specific ways. Six years ago, when I started to work with paper and electronics, I saw how educational organizations were taking notice of making as a resurgent affirmation of the value of hands-on learning in an age of technology, but in that scaling activity, there were challenges. Low-cost hardware often required an understanding of basic electrical engineering and new programming languages; packaged kits might blackbox functional and material encounters so interactions with interfaces, inputs and outputs were simplified, diminishing learning opportunities for working with or assembling systems; and often these products were mainstreaming at price points that would put the experience well out of reach for learners who might benefit the most.

At the same time, our collective migration to the cloud, via apps and social networks, was helping to drive adoption of computer science in K12 classrooms. This suggested, in turn, that fluency with data and activated civic engagement would become the next essential competencies worthy of attention from learning designers and institutional education. I started thinking about data as material (zero marginal cost) and the notebook + low-cost electronics (limited expense per learner) as an accessible, user-friendly way to develop new skills and literacies through creative documentation and exploration.

Natalie and collaborators at NEXMAP.org, the small non-profit I work with, began exploring these ideas as a learning stack in a series of prototypes we called the Open Data/Open Minds project.[12]

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10 'Data Navigators 2.0', *Providence Public Library*, https://www.provlib.org/education/teen-squad/data-navigators-2-0/.

11 'Civic Switchboard Fieldwork Grants', *Civic Switchboard,* https://civic-switchboard.github.io/post_13/.

12 'Open Data/Open Minds', *NEXMAP*, http://www.nexmap.org/open-data-open-minds.



Fig. 3a. David Cole, Notebook work in two learning settings: 3rd grade unit activity with science notebooking, San Francisco, CA, 2017; teacher professional development workshop on Advanced Paper Circuitry, Kodiak, AK, 2016.

Notebooks: Grade 3, San Francisco. Geology Unit, four lessons, each one includes a paper circuitry activity; students make their own battery clips, document their learning.

The culminating activity is a demonstration portfolio – two pieces of paper, folded, cut, nested to make a four-part sequential reflection for each lesson.

A final illustration and circuit story for the project, structured as an open storyboard, with illumination.



Fig. 3b. David Cole, Notebook work in two learning settings: 3rd grade unit activity with science notebooking, San Francisco, CA; teacher professional development workshop on Advanced Paper Circuitry, Kodiak, AK, 2016.

Notebook: Middle School Teacher, Advanced Paper Circuitry Workshop, Kodiak, Alaska. First soldering attempt - using notebook as practice space.

Documentation on ATtiny85; first effort with the microcontroller failed; annotations with the burned out IC; Arduino introduction and sample code sketch for experimentation.

Alternating LEDs tell a story in sequence in a circuit and illustration; a servo setup for a foldable panda whose head rotates; from Automate Your Ideas, booklet #4 in the Hack Your Notebook series.



Fig. 4a. David Cole, Paper and Electronics: projects, prototypes, collaborations, 2016-2019.

Natalie Freed's workbench, final steps for the project in Program Your Pages – copper tape, microcontroller, circuit sticker, art work – the second volume in the Hack Your Notebook series.

Program Your Pages; teacher leaders working on a project, preparing to solder; demonstration in a journal.

Open Data/Open Minds – Pop-up Data Dashboard for Austin, TX; real-time feeds for temp., AQI, traffic, time; on display at Mozfest 2017 w/Dr. Elisabeth Sylvan, photo: Ana Lutzky @AEFsuprecherche.

Scientific Adventures for Girls at UC Berkeley, Dept. of Engineering, photo: Adriel Olmos; STEAM Learning Intersession w/East Bay Innovation Academy, Oakland, CA. 8th grade: paper circuitry and design.

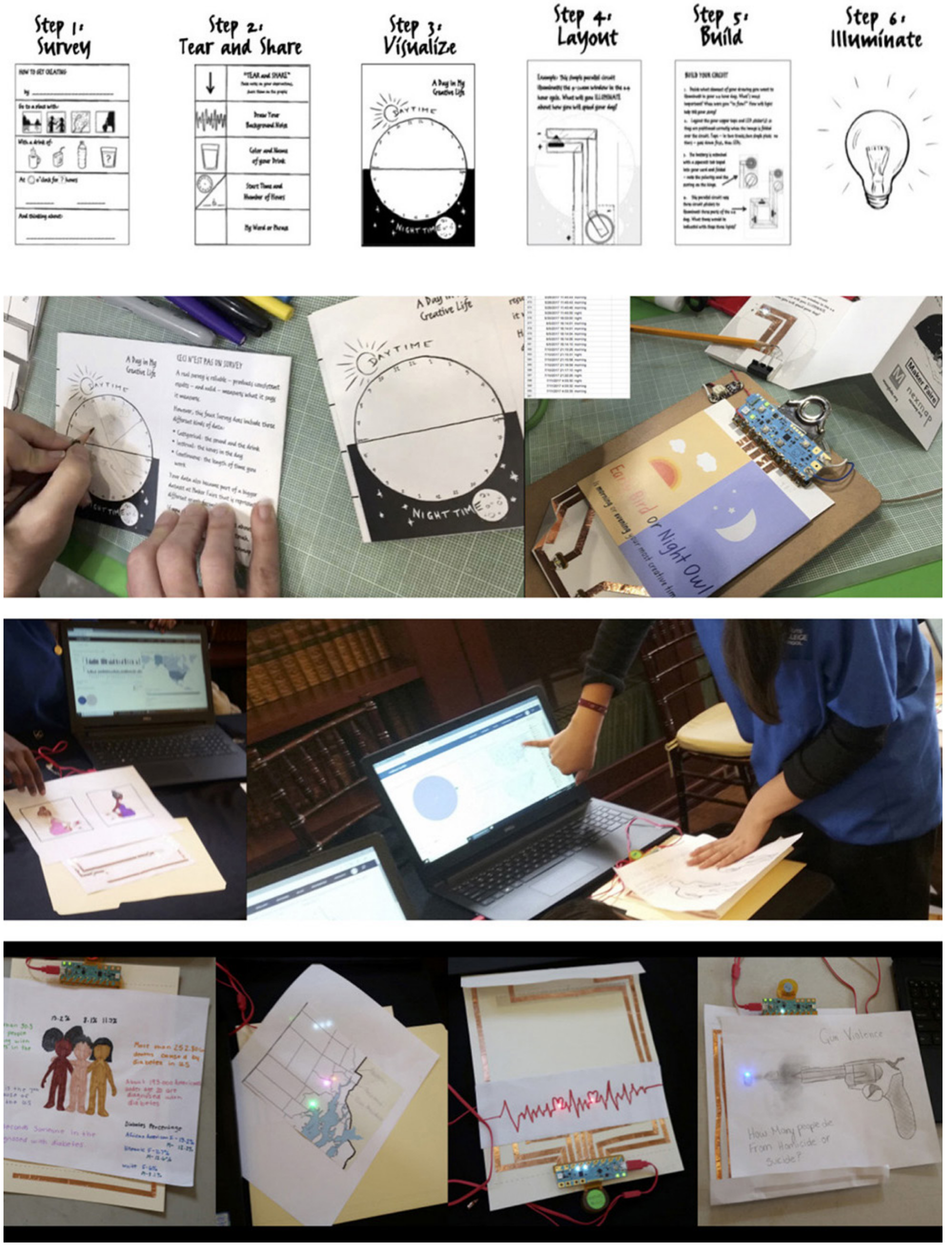


Fig. 4b. David Cole, Paper and Electronics: projects, prototypes, collaborations, 2016-2019.

Steps for a workshop activity at Maker Faire 2017 – Data viz on paper.

Noting daily activities in preparation for adding emphasis with light from an LED; prototype for Paper-to-the-Web: a paper circuitry polling tool; data sent to Google Sheets.

Final project showcase for Data Navigators program at Providence Public Library, June, 2019; Tableau workbooks and paper circuit projects.

“Low Resolution Data” projects on paper by high school students in the Rhode Island Nurses Institute Middle College High School program.

The tension and opportunity in this work – the broad, associative, real-time connections that come with networks and the deep, particular, tactile work that occurs with physical objects – animated my exchanges with Hannah.

I'd describe how, in contrast to her experiments and explorations with distinct materials and physical properties, I'd be thinking about groups, people, institutions, and looking for gaps in experience, places where agency – in whatever form – is lacking. I wrote to Hannah about our planning work for the visit in May, '[...] I see a library running a data literacy program for youth and think: this is remarkable, a civic institution is providing young adults with publicly-funded pathway experiences so they can become fluent in the language of data visualization – in the way one might have learned PowerPoint twenty years ago, as a leg up in the workplace'. We hoped to support this proposition by introducing crafted projects and physical materials alongside a computational application, Tableau, as a complementary GUI assembled from paper and electronics, bits and atoms, which would function as a screen does: as an invitation to explore ideas, share stories, and work with information in ways that create agency and opportunity.

(S)low Resolution Datavisualization: Building Situated Literacies

There is one question that comes up often, pointing to assumptions about certainty/uncertainty and open and closed systems, and kits of parts vs. no parts. Why bother with paper, electronics, and this combination of craft and technology when we have computers in our pockets? It is worth exploring the kind of value that gets added if we take a slow approach, take apart a technical system, and use the parts to reassemble a piece of our understanding with familiar physical materials.

In Providence, the high school students participating in the data course at the library were all 10th grade women, many of them from immigrant families from Latin America and Africa. They were enrolled at the Rhode Island Nurses Institute Middle College, a public charter school providing students with experience in the healthcare industry as part of their high school coursework; they arrived at the session in their medical scrubs – their dress code when visiting or assisting at hospitals and nursing homes during class trips or internships.

Our craft and materials excursion with paper and electronics was a hands-on supplement, what teachers call, 'a push-in unit', intended to offer a new way of looking at their data research. Topics the young women were working on included: infant mortality rates, various cancer cases by state, diabetes statistics, lead levels in school drinking water, teen pregnancy levels, and the rate of homicides and suicides involving guns.

In the afternoon, we met with adults who'd completed a similar course in Tableau. This group of 12 people, ranging in age from 25 to 84, included a congressional representative for the state of Rhode Island, all of them interested in expanding their experience with technology. One woman, a high school Spanish teacher and new mother, had taken the course prior to her maternity leave. Thanks to training she received for free at the library, she's now able to work from home as a business analyst.

What we found with the groups in Providence, where making and physical computing were completely new ideas, is that the simple set of materials allowed participants to be playful and articulate what they were seeking to share. Calculations and decisions about how to contextualize information so it could be read in an output and interaction on paper – a blinking LED and a switch, say – turned into useful exercises at reverse

engineering a kind of word problem. How shall I use a light to render a mortality rate for a given region? What's my blink rate for what period of time? What's the division and arithmetic I need to get a number and an output that's meaningful? Shall I create a circuit that positions the lights spatially, as illumination under points on a map? What colors, brightness values, and rates of fading might I use to reveal which details?

While computational systems are uniquely suited for organizing volumes of information with extraordinary consistency and speed, paper, too, is a system of its own, with unique characteristics and associated literacies. It's a brilliant representation of the singular complexity and character in a physical material. For learners new to ideation and iterative production work, the affordances of paper reside in its tactile constraints (two-dimensional, fixed sizes) and flexibility (ready to be modified, configured, annotated, reshaped). In this fashion, it embodies and offers a means of demonstrating how ideas can be realized, tangibly, through materials. These ideas can be shared in 1:1 relationships – person-to-person rather than the one-to-many networked connections we've grown accustomed to via our technologies.

The introductory training the students in Providence received in data research and cleaning, and their understanding of what they would do with their findings on screen, in Tableau, provided them with the background and nascent domain expertise needed to transfer their thinking to materials, to contextualize their grasp of the information, miniaturize it in certain ways, zero in on specific details, and quickly assemble simple demonstrations on paper, by hand. For example, the new mother in the adult class proposed a circuit system using two LEDs and their respective blink rates to contrast the numbers of women giving birth to healthy babies with and without the access to the assistance of a midwife.

What emerged in this introductory project and collaboration was the kind of thinking that underpins the development of a problem statement – an essential articulation of critical thinking and scientific inquiry that's central to every data literacy experience. For first-time learners, even with very basic demonstration projects, paper and electronics became expressive vehicles for personally relevant questions and storytelling.

Epilogue: Untangling Strategies

Coming out of this joint reflection on our practices, we realized some of our approaches, attitudes, and tactics show significant overlap. Firstly, centering sociality and collaboration with other people and the material itself as peers or conversation partners. Secondly, our shared dedication to understanding electronic materials as having certain properties that can be connected together to have something else emerge (rather than things with delineated functionalities we can utilize at will). And lastly, the objective to allow ourselves and others to explore in terms of a workmanship of risk.

How shall we describe our approach to making and materials?

David: Today's technologies and online networks are proof of our abilities to communicate and collaborate on a global scale. Electrical engineers can design and manufacture the circuits and systems that enable these connections without encountering any materials; their understanding can remain focused on design principles and abstract descriptions of electrical and physical properties in component datasheets. In contrast, an electronic craftsperson produces and works with technologies informed by encounters with these materials in order to explore possibilities for new or alternative outcomes or designs. A workmanship of risk elevates the energy and integrity of process, and the idea of multi-

farious expressions for materials and ideas. It's a reflection of how an individual vision, impulse, or question develops, something unique to the craftsperson, the learner, and the material being worked and considered.

Hannah: Many of our newest tools and techniques for collaborating with materials allow us to do so in remote CAD/CAM ways. These technologies insert a translator between ourselves and the materials, interfering in our material relations in order to achieve predictable and repeatable outcomes. Working with these translators can lead to wonderful conversations,[13] but they distance us from the materials, prioritizing mental modeling over bodily encounters. David Pye refers to these styles of making as a *workmanship of certainty* and a *workmanship of risk.* In the latter, at every stage in a creative, materials-based encounter, an outcome or finished project is not certain. In this sense, the making of the object is always at risk. I would like to expand Pye's notion of taking 'risk' in workmanship to include the risk taken in departing from familiar frames of reference. In doing so, one might fail to make meaningful connections with established frames of value. This is the risk of getting lost and not returning.

What is needed to achieve a workmanship of risk?

Hannah: To promote more risky workmanship with/within complex technologies we should be looking at tools/ways that aid the sharing of information and the collaboration between humans and non-humans (materials), and the creation of support structures that encourage us to venture out into new territory. We could start by changing our language around collaboration.

- To give credit where credit is due: to others, to materials.
- To create time, space, funding, and recognition for basic experimental research.
- To be honest about our endeavors and to reframe what is so often called 'failure' as a necessary part of any process.
- To realize our connectedness within complexity.
- To be interested in our own process and the becomings of our projects and ourselves.
- To teach risk taking through individual curiosity, one can provide earners with opportunities to experience the full cycle – venturing out into new territory and experiencing the richness of insights learned from 'failure' before returning 'home' with a new perspective.

We can be alert to the affordances and especially the limitations of the platforms and language we use that enable us to share these experiences as collaborators, contributors, and listeners by creating situated spaces and environments for this kind of learning. And, in turn, we can cultivate narratives that capture insights and lessons learned so they can be folded back into one's self, creating semantic links between 'process' and 'person'.

Can a workmanship of risk be achieved practically on an institutional(ized) level, and is this necessary?

David: Coming at a making practice as an educator I respond to the criteria Hannah offers by thinking about the spaces where we learn and the structural elements that limit or inform how our time is organized. The character and organizing principles in our learning settings condition us for specific outcomes. I'm interested in common planning time and professional development

13 Hannah Perner-Wilson, 'Their Sequence Depends on a Bewildering Number of Factors', Autodesk Pier 9 Gallery Presentation, *Plusea,* 2016, http://www.plusea.at/?p=5744.

for teachers – school buildings and learning spaces with flexible plans that allow students to gather informally and work quietly or loudly as needed. I also see possibility in block schedules in a school day. These allow educators to collaborate across subject areas, creating openings for open, interdisciplinary thinking that prioritize new perspectives and the remixing of ideas.

And then there's the question of how communities and the projects they undertake are led – the leadership element and the roles of mentors, partners, and coaches. Whether it is a program director or, to Hannah's points, the language used to describe goals and expectations, these ideas take me back to how I started down this path. I'm interested in an arrangement of opposites, like wood and words, and the way physical attributes and materials combine with generative, social rituals and expectations in learning situations. Making brings these things to the center of the conversation. Such an approach prioritizes the experiences of learners and also comments on the breadth and complexity we now live with – the intricacies of our technologies, the diversity of community experience, and the socioeconomic disparity that is so pervasive. We need to think and listen and design intentionally like this if we're to make room for iterative, personally meaningful ideas that emerge in our encounters with materials.

What are we taking away from this process of reflecting on our practices?

How has the process of writing this publication impact our thinking about our practices?

Hannah: During this process I observed myself falling for two illusory extremes. On the one hand, there was the illusion that I could use this new knowledge and insight to optimize 'my' process, to (re)gain control. This was an illusion because I was wholeheartedly experiencing the limitations of my control. On the other hand, I found myself falling for the idea that I could let go, go with the flow, give up control, let the materials lead me. While enticing, this submissive stance is impossible given my recognition that I am constantly directing my energy and influencing the system, and thus unable to *not* exert any control. Given these two extremes, the middle ground appears closer to reality: to make is to collaborate, to negotiate energies. I can neither take nor lose control, only channel my energies in one way or another. More than ever before, I feel a sense of making being all about collaboration with materials.

Thinking about the kit-ification of things, I'm no longer sure that a no-parts approach stands in absolute contrast / in stark opposition to an accumulation of functionality into parts, but rather seeks to press for an open-ness to these elements or components in a material encounter. I think of open as in *freedom* of information (access to and sharing of), but also open as in *open-endedness*. Such a demand for open-endedness is not only directed to those who package and portray the details of a part, but also at the mentality of the person drawing upon this part in their practice. How can we think open-endedly? My idea of a workmanship of risk describes a process that is at ease with not always knowing where one is headed.

David: Collaborating with Hannah on this piece reminds me of the value of collisions between practices, formats, and materials. These encounters reorient our points of view and create openings for deeper investigations. In our letter-writing, it was energizing to observe how completely Hannah gives herself to material encounters. From time to time I would check back on some of her project URLs and lucid documentation to remind myself of the skill with materials she's simultaneously relying upon and letting go of.

For me, the tension and energies in that posture towards materials and engagement found a correlative in the fact that Natalie and I had been invited to insert an introductory paper and electronics activity into a time-bound syllabus and course schedule about information research routines and how-to steps with an enterprise data visualization platform. There was a disruption of possibilities in that invitation. Together with our partners at the library, the coordinators and the students, we were agitating both systems, so to speak, starting down a path that will teach us things about how to push at the limits and possibilities in a diverse collection of materials, and in our own lived experience.

Hannah: What I hope to have gained from this experience is a heightening of my senses, enabling me to become a better listener and a better material collaborator (maker). By better, I mean capable of taking into consideration a greater number of factors – more holistic. What I secretly fear is that I've taken a false sense of objectivity from this process, a form of clarity. What appears to me as a newfound holistic ability actually stands in my way of allowing myself to 'be material'. As a next step, I'm really curious to talk with David about how such a reflexive exercise (as this one we just completed) could be introduced in a learning setting/ as a learning experience.

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Making (Things) as Ethical Practice

Wim Nijenhuis

MAKING (THINGS) AS ETHICAL PRACTICE

WIM NIJENHUIS

Matter Matters: a Reconfiguration of Classical Design

The culture of making in architecture reconfigures classical architectural practice through its emphasis on being engaged with material – on doing instead of abstract thinking and planning. Its 'revolutionary' principle can best be demonstrated through a microanalysis of what the maker actually *does,* in comparison with the classical architect.

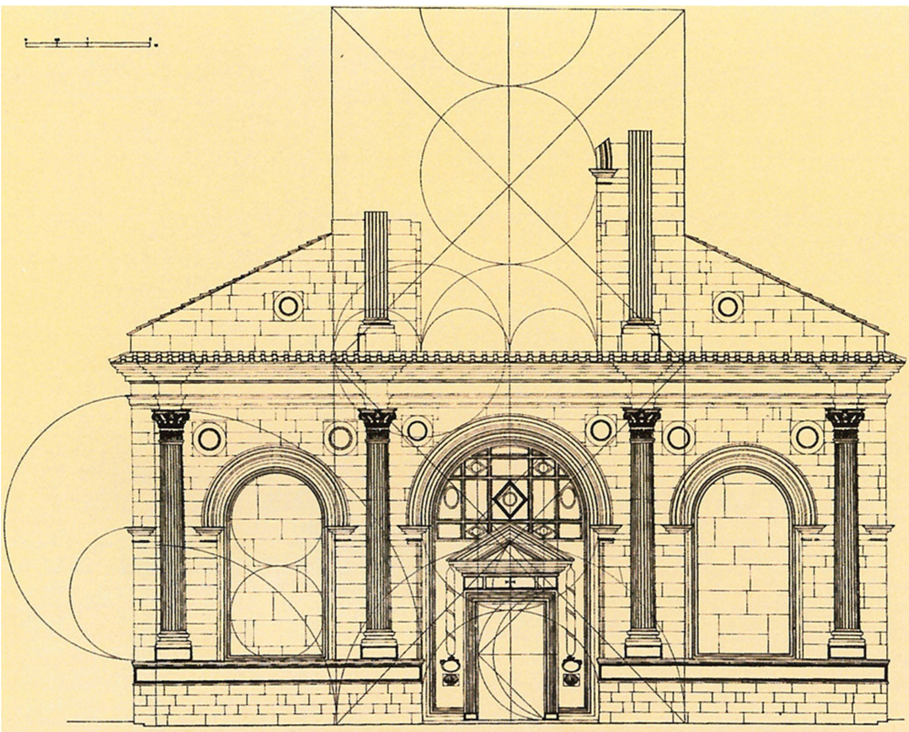


Fig. 1. Geometric projection of conceptual image from Leon Battista Alberti, Study of proportions of the facade of Tempio Malatestiano, *1447-1468*.

Since the quattrocento, when the discipline of architecture diverged from the medieval crafts, it has been regarded as an abstract intellectual activity, a discipline of the mind, devoted to reason. In this way it was incorporated in the humanist movement, who saw man as determined by mind and language. The Renaissance architect and theorist Leone Battista Alberti (1404-1472) depicted the architect as a person with a 'developed intellect and imagination',[1]

1 Leone Battista Alberti, *On the Art of Building in Ten Books,* trans. Joseph Rykwert, Neal Leach and

one able 'to imagine whole forms in his mind without taking any notice of the materials'.[2] The special feature of architecture since then has not been so much its focus on the concrete building, (which was seen as the object of 'construction' industry), as the abstract drawing. The latter is considered the mere projection of an idea that has been developed by the 'genius', the 'ingenium' – that is to say, the creative spirit of the architect/engineer.

The core concept of architecture concerning the relation between creative spirit and drawing is 'design', derived from the Italian *disegno* and meaning 'the visual expression and clarification of the concept (of a building, W.N.) that someone has in her mind and that he imagines in her thoughts and builds up in the idea'.[3] According to this definition, disegno has an abstract and a material side. The abstract side, 'theory', is the way in which the representation is formed in the mind of the architect. This abstract image is subsequently directed to her hand, which in turn concretizes it in the drawing, the latter representing the more material aspect of disegno. Note that in this definition the hand is a pure mechanical implement, mediating between the creative spirit and the drawing.

Making (things), on the other hand, is a physical affair. It does not occur between mind and drawing, but between hand and material. We might describe it as an activity in which physical and (in)organic entities of various kinds come together to take part in a complex process of metamorphosis that brings into being material things. As long as the activity of making endures, we can observe the appearance of a dynamic and variable *assemblage,* which is composed of material bodies such as wood, steel, stone, paper, textiles, clay, etc. – including tools – and also hands, eyes, and brains. Sometimes the latter series is extended with the mouth, the feet, the knees, the forehead, the ears, the nose, the back, and eventually the complete human body.

Compared with classical architectural design, we can understand making as a critical reconfiguration thereof. To be engaged with materials without thinking, i.e. without making a drawing beforehand, is crucial here, because to bypass the prominent position of the idea – which is the essence of design (read: disegno) – is a serious attempt to abandon the disregard for the material and to give it a voice. To be engaged with materials without thinking beforehand means to drop control and go along with matter.

The second element of the reconfiguration of design concerns the emancipation of intuition and the change of its nature. According to the humanist theory of design, intuition is bound to purely spiritual processes and feelings, which are limited to the inner space of the human body. Makers, however, understand intuition as a reciprocal faculty that is shared with matter, seeing making as an inimitable interplay of influences.

Robert Tavornor, Cambridge, MA: MIT Press, 1988 (1452), p. 63.

2 Alberti, *On the Art of Building,* p. 7.

3 Giorgio Vasari, *The Lives of the Artists*, trans. Julia Condaway Bondanella and Peter Bondanella, Oxford: Oxford University Press, 1998, pp. XI, XVI. Or: *Le Vite de' Più Eccellenti Pittori, Scultori e Architettori*, Firenze: Lorenzo Torrentino, 1550.

The third element of reconfiguration is the concept of creativity. According to humanist design theory, creativity is trapped inside (the space of) the human mind and considered to be the exclusive agency of all making. By assuming a different metaphysical position, makers can acknowledge non-human agencies like the active and semi-autonomous answer of matter or the counter-objection of the tool. In short: by breaking open the humanist subject of creativity, makers create space for a dual or even triple creativity principle.

Finally, the reconfiguration of design also affects the concept of vision. Through making, this internally-oriented spiritual faculty that enables the visionary person to see 'things to come', or 'things to be realized' is transformed into an externally-oriented capacity of observation, be it connected with sentiency, intuition or fantasy...a real *art* of observation...with the eye and the hand...an observation that searches in the appearances of real substances for meaningful possibilities to continue the event of making...

To conclude: the typical design process follows a set sequence of brain > hands-tools > eyes > drawing. In making, this series is reconfigured, becoming material > hands-tools > eyes > brain. These two series characterize the difference between the thinker/drawer with her abstract planning, and the maker who participates in the material process of making, between the fixed controller with an overview and the traveling *explorer*; an open-minded sojourner, ready to make the most interesting discoveries along the whimsical paths of her journey.

Making and Architectural Practice

Making is easier done in art then in architecture. The artist can dedicate himself to making by simply skipping the phase of mental concept development and letting the artwork come about through direct experiments with the material. Architecture is stuck here with a deep division of labour between the design of a building and its actual construction. Maker-architects have developed various answers to this problem. Some present themselves as artists and try to restore the broken link between design and execution. Often they quit architecture, temporarily or conclusively, and dedicate themselves instead to making as a sculptural exercise. Others prefer to integrate elements of making in their design processes by paying special attention to creative modeling and sketching. All recognize in making practices opportunities to experiment with design methodology.

In architectural schools, making always implies the direct tactile contact with concrete materials like wood, clay, foam, steel, stone, twigs, etc. For that reason, it is seen as an activity through which much-needed material knowledge – which designs often lack – is developed. In addition, the junior architects are highly sensitized to material reality, a reality that for most of them is troubled by the rising pressure of what might be called real-life surrealism, spread through the professional world by electronic communication and the use of half-automated design software such as AutoCAD.[4]

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4 Makers in architecture know that in daily practice they cannot avoid electronic, computerized design-tools, but they resist them becoming the unique method of design. They insist on enriching the design activity with the processing of concrete materials. Note that hacking and manipulating electronic tools

According to some makers, architectural education should be one big exercise in making. It should function as a research tool to investigate the way in which architecture manifests itself through its materials. The architect who integrates an episode of working with materials into her normally rather abstract design method learns to understand that architecture can very well have poetic expression through the play of material, space, and light. Students come to realize that these poetics are the result of the way in which they have organized their working method and not the outcome of the implementation of such a thing as style, be it historically or theoretically motivated.

To illustrate what making means in architectural practice, I will describe one of the workshops that were held around 2007 and represent the first manifestations of the culture of making in Architecture in the Netherlands.[5] The participants were students of the Academies of Architecture of Amsterdam and Arnhem.

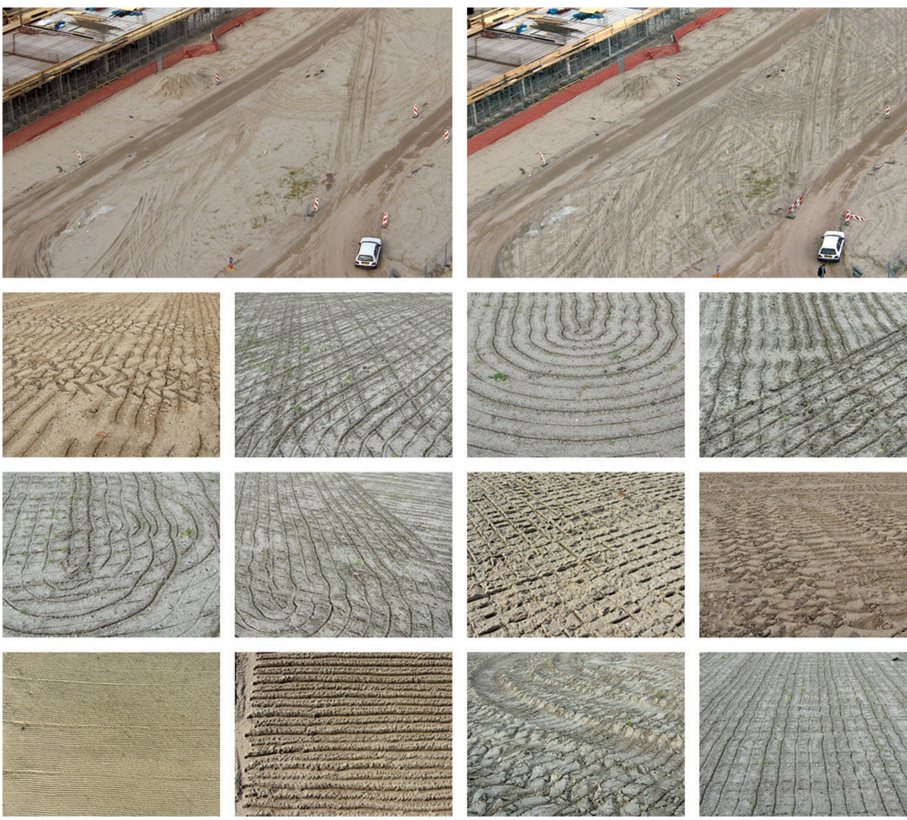


Fig. 2. Machiel Spaan and Jan Peter Wingender, making with sand in a sand plain, 2007.[6]

by means of active programming was already an activity of blob-architects in the nineties.

5 Machiel Spaan and Jan Peter Wingender, *The Temporary Expert,* Amsterdam Academy of Architecture and Arnhem: ArtEZ Academy of Architecture, 2008.

6 Reprinted with permission of the creators.





Fig. 3 and 4. Michael Spaan and Jan Peter Wingerder, making with sand in a sand plain, 2007.[7]

7 Reprinted with permission of the creators.

Equipped with tools such as measuring tape, construction wire, pickets, and a shovel, student/makers were asked to work on an empty sand plain near Amsterdam. Nothing had been built here yet and only the geodetic indications of the plots, a few bridges, and a park could be seen. The actual material they were assigned to work with was the sand, tangible, visible, and changeable sand. Though a seemingly monotonous landscape, uneven terrain, tire tracks, sunken places, and all sorts of other details encouraged exploration.

The students were instructed to look for an inspiring location and start working there. They had to take into account the topography of the area and the texture of the surface, and were expected to improve the relationship of these features at the spot they had chosen to develop. They also had to organize their work in a cycle of doing, contemplation, and anticipation, which had to be repeated several times in each session. It was explicitly forbidden to make a drawing first. Instead, they were asked to intuitively begin, and then iteratively improve through a cycle of constant reflection and modification.

The work was carried out in four sessions of half a day. All actions were recorded with photographs, films, and sketches. Afterwards the experiences were presented at an evaluation meeting with all participants. Ultimately, 21 locations were worked. Together they provide multiple impressions of the sand plain that testify to the potentialities of the sand material and the topography of sand plain – including the confrontation of the makers with the sun, the wind, and the water.

The Miracle of Making

The material and the location, which the participants of the workshops of 2007 called *poetic seducers,* were crucial factors of inspiration for them. Because the participants stayed as close as possible to the respective locations during the time the workshops were held, the events assumed the quality of a *retreat,* intensifying the focus on material and location. The multiple cycles of repeated activities they had to go through in a short time minimized the influence of theoretical considerations. Short working periods of three to four hours created the need to hurry in order to get results, leaving no time for thinking. Working in groups subsequently compensated the reduced capacity for production and improved the perception of the material and the situation due to the verbal and non-verbal consultations by the group members.

Each workshop ran according to a cycle of assignment, execution, and presentation. Documentation of the process with photos, film recordings, and sketches created a mode of perception that was mediated by multiple information carriers. It sharpened gaze and thought, and created a productive distance that helped to keep the overview. By repeating the cycle, skills were developed and a proficiency emerged regarding the different working methods. Through all these features of the process, the makers gained a rich knowledge of the potentialities of the location and the materials.

The participants were not allowed to seek guidance in scientific knowledge, be it of a technical or an architectural historical nature. No one was allowed to start working with a final image in mind. The purpose of this was to learn to accommodate the *unforeseen*, whether it came from

the material or from the location or the circumstances, and to develop the ability to respond by *improvisation*. In fact, the participants discovered that the resistance of the material against its treatment quickly subverted any pre-planned idea. In the end, the workshops promoted the insight that the final outcome was not controlled by the human mind. The result did not derive from an idea beforehand, but from an unconditioned interplay of hands, eyes, brains, materials, and tools, where ideas only could pop up and play a role from the sidelines, insofar as they were connected to the action in the moment.

In a mysterious way the interplay of the material, the location, the hands and brains, the contemplative perception, the interim (re)presentation and reflection – all these depend on the working method. Complicating the working structure through repeated cycles – which could, in principle, be continued indefinitely – often provided a surprising result, a result that struck makers with *amazement*, as if they had contributed to the creation of a *miracle*. Why? Because they had outsourced the subject of initiative, the 'creative spirit' to the *assemblage of making*, to a set of physical connections in action, to a true 'dance' of the agencies of materials, locations, tools, and human hands, eyes, and brains.

The Integration of Making in the Classical Design Process

So far we have discussed making as being engaged with materials, putting the creative spirit aside and aiming for the production of miracles through complex working procedures. In spite of its different configuration, making can be integrated into the classical design process by including special phases dedicated to creative model building and sketching. Using deliberately vague instructions, some architects ask their employees to produce a large quantity of models made of styrofoam, clay, or wood – the most appealing of which are selected to serve as inspiration for the actual design. Others collect readymades in nature and use them as inspirational models for their design (Fig. 5).[8] To emphasize the contrast with the fancy demonstration models of classical designers, makers improvise more, and use organic models in order to play off the intrinsic expression of the materials against the imagined forms of their traditional opponents. For instance, in their architectural models for an apartment in Pratteln, Switzerland, the architects of Christ und Gantenbein used a pile of irregularly sawn pieces of wood that could hardly be distinguished from firewood for the stove.

As for sketching, architects are looking for ways of drawing that can be regarded as manual work, working a material until it amazes the drawer. In his *Notebooks*, the painter and Bauhaus professor Paul Klee (1879-1940) defined the line as material, noting that a sketch drawn by hand is not so much a mental projection as the *trace of a movement*.[9] More materialistic still is the following thesis: the lines of a sketch launch themselves from the pencil where they originate, recording their own sinuous path in the wake of the drafter's moving hand. In short, every line drawn by hand is material by nature, because every line is the trace of a gesture.

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8 Ready Mades as elements for the model of a city, Alex van der Belt, 2013, photo Wim Nijenhuis.

9 Paul Klee, *Paul Klee: Notebooks, Volume 1: The Thinking Eye; The Notebooks of Paul Klee*, Jürg Spiller (ed.), trans. Ralph Mannheim, London: Lund Humphries, 1961, p. 105.



Fig. 5. Alex van de Belt, Readymades as elements for the model of a city, 2013 (photo Wim Nijenhuis).[10]

In architectural practice, we can distinguish two types of lines: expressive (or gestural) lines and non-expressive lines. They can be distinguished on the basis of their intention. The purpose of expressive lines is to express the movements from which they originate, while in the non-expressive lines expression is an accidental side effect. Non-expressive lines form technical drawings, mere propositions about what needs to be made. Expressive lines exceed proposition because of their explicit determination by physical gestures. In other words, their state of 'being made' is more significant than their capacity for representation. What these lines share with the material of making is their ambiguity and ability to indicate paths that the maker can follow. That is why sketches require careful observation, one tailored to their specific appearance.[11]

The sketch is of great importance for architects in developing ideas. It can only amaze the drawer, however, when she no longer regards the hand that draws as the obliging implement of the projective mind, but as an active and disobedient organ that cooperates with other organs such as the eyes and the brain. She may not longer conceive the brain as the origin of the initiative, but as the organ of following, perceiving and inner projection. What is surprising is how quickly – after the activity of the hand has created the play of lines on the paper – the

10 Reprinted with permission from the photographer.

11 Tim Ingold, *Making: Anthropology, Archaeology, Art and Architecture*, London and New York: Routledge, 2013, p. 50.

mental representation arises through seeing it. John Berger (1926) nicely summarizes this dialectic between external and internal reality: 'Every line that I draw changes the figure on paper, and at the same time, the figure is traced in my mind as a result'.[12]

Just like the event of making, impulses from outside – visual, tactile, muscular, or physical impressions, or even just vague feelings – inspire the sketch, because the drawing hand converts all these sources into a set of lines. In order to do justice to this conversion, the Finnish architect Juhani Pallasmaa explicitly situates the creative principle of the sketch in the *dynamic assemblage*, in the very act of drawing itself. To him it seems 'as if the drawing draws itself and uses the human hand as its instrument [...] Often it is the drawing itself, the intense involvement in an "unconscious" act that causes an image or an idea to arise'. Pulling lines is like working materials because ideas are merely pulled out, or pulled up from the play of lines as if it were a play of materials. Some architects say that in sketching, the hand that draws 'feels' the forms to come. The drawing hand as a haptic, amazing 'trigger' of ideas is making culture's retort to the always-controlled hand of humanism, the mechanical slave that merely implements the ideas of the mind.

Anthropological Repercussions

Architects may turn to making with the expectation to develop new forms, but as we've seen, making also implies anthropology, another definition of man. Makers question the humanistic thesis that our intellectual faculties such as thinking, speech, and technology determine our humanity, replacing it with a more physical, materialistic, and non-anthropocentric vision.

What are these anthropological repercussions? Does this shift entail that makers make themselves when they make things? Theorists and practitioners say yes and distinguish between two types of making: the formation of character and the improvement of physiological aspects. Through making, the maker acquires specific skills, but also develops character traits: enthusiasm, observational attitude, familiarity with uncertainty, an ability to improvise, self-discipline, self-confidence, and humility. On the physical side making improves body parts like the hands and brain – or at least saves them from further regression.

Typical for making is its energy-generating effect. The German art historian Oliver Zybok relates this energy to the obsessive person, who is 'extremely focused on something and shows an excessive energy that is spent on one specific interest'.[13] Here, the negative characteristics of this syndrome – the emotionally charged field of tension and the additional, often unproductive urge for perfection – are restrained by the 'steady rhythm for work' of the maker and her focus on 'concrete objects and procedures'.[14] Thanks to the self-discipline acquired by the nature of her activity, the maker succeeds in transforming her enthusiasm into a fruitful

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12 John Berger, 'Berger on Drawing', in Jim Savage (ed.) *Berger on Drawing,* Aghabullogue: Occasional Press, 2007, p. 112.

13 Oliver Zybok, 'Lust und Zwang der Obsession; Betrachtungen in Kunst und Gesellschaft' [Pleasure and compulsion of the obsession; Reflections in art and society] in: 'Obsessionen I [Obsessions]', *Kunstforum International, Bd 225,* März-April 2014, p. 63.

14 Richard Sennett, *The Craftsman,* London: Penguin Books, 2009 (2008), p. 254.

and healthy variant that Richard Sennett has labelled *constructive obsession*.[15] Because of this self-discipline, obsession loses its pathological traits and becomes *enjoyable*. Constructive obsession, self-control, and pleasure become character traits of the maker, because a well-defined working process allows her to escape from herself.

Secondly, making encourages the acceptance of imperfection, pushing us to go along with accidental slip-ups and failures, or better yet, to perceive them as *salutary*.[16] To make this happen, the maker needs to recognize that slip-ups point the way to a free and personal attitude towards the basically unbeatable quality standards and paragons of perfection that are imposed on us today by the industrial production and the circulation of electronic images. Making helps us avoid the depression that often results from slavishly following the paragons of visual culture, teaching the maker to rely more on herself. The lesson of *salutary failure* is: 'Discover your own way; innovate, don't imitate!'[17]

These character traits have their origin in working materials. That is why making also has repercussions on human physiology. It is clear that, through working materials, we train the hand. In doing so we improve proficiencies, proficiencies comprised of individual expression. Do we not say 'the master's hand'? Faced with the continuing regression of the hand and the loss of its expressiveness caused by the degradation of the fingers when operating the computer mouse, working materials restores some qualities the hand possessed in the past when it was still a highly sensitive organ with spiritual repercussions. French anthropologist Leroi-Gourhan put it this way: 'that we don't have to "think with our fingers" is equal to the lack of a part of someone's normal phylogenetic human mind'.[18]

In his book about the craftsman, Richard Sennett concludes that anyone who has learned from working with materials to be patient, to control herself, to observe the materials sentience, and to move with them, also has the skill to avoid the counterproductive use of reckless and brutal violence in daily life.[19] Working with materials enables people to govern themselves and so become good citizens.[20]

Ethical Practice

Being good is an ethical matter. Our culture understands ethics as something close to morals, i.e. a set of rules that tells us what to do and not to do in daily life. We experience morals often as restrictions. Character also determines behavior. However, its mechanism is not prohibition but building a set of habits, of fixed behavioral patterns that we internalize through constant repetition over a longer period. We know this mechanism

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15 Sennett, *The Craftsman*, p. 254.

16 Sennett, *The Craftsman*, p. 97.

17 Sennett, *The Craftsman*, p. 102.

18 André Leroi-Gourhan, *Gesture and Speech*, trans. Anna Bostock Berger, forw. Randall White, Cambridge MA: MIT Press, 1993, p. 90. Or: *Le Geste et la Parole*, Paris: Albin Michel, 1964.

19 Sennett, *The Craftsman*, pp. 169- 171.

20 Sennett, *The Craftsman*, pp. 268- 269.

from sports. It teaches us that people can become dedicated to repetition because it is immediately rewarding. When the maker experiences an improvement in performance, she is drawn into the steady training scheme that is needed to acquire skills and to change habits.

In his popular masterpiece *You Must Change Your Life*, the German philosopher Peter Sloterdijk highlights this mechanism, calling it 'anthropotechnics', techniques of individual and collective self-transformation.[21] Making is anthropotechnic because it is rooted in the convergence of manufacturing and practicing. Making is tantamount to the acceptance of learning through repeated physical exertion, including its slow pace enforced by working materials. Going a step further then Sennett, Sloterdijk proclaims that through techniques such as targeted training, (relative) isolation – be it alone or together with others – and *Bildung* (spiritual education), we can develop our own, preferably socially deviating, way to a superior performance that is determined by ourselves, including our bodies.

Sloterdijk sees an opportunity here to promote the formation of alternative personalities, people who are willing to acquire good habits like care for the environment or extend courtesy towards their fellow human beings. Since the Enlightenment, we consider personality to depend on an inner regime that consists of a combination of innate and learned ways of responding and acting. We now understand that the maker – through the conscious repetition of certain activities and developing self-discipline by working materials – also acts upon her own inner regime of behavior. When she changes her existing regime (e.g. sitting in front of a computer, or watching television, or hurriedly acting) through making, she changes her personality in an active way. Making is then a means of personality transformation: by working materials, the maker remakes herself.

Being a good citizen means having good habits. Good habits presuppose that humans have a certain degree of control over their affections and passions. This 'ability to govern yourself' can help to make a stand against being governed by the many subliminal effects of advertising on classical and social media. Making can help you to become a consciously trained world citizen, fit to face the disasters of the Anthropocene.

Becoming a good person through training, however, requires a new understanding of ethics. The link between character formation and mental-physical training is an unjustly forgotten dimension of ancient Greek ethics that we need to rediscover. The philosopher Aristotle argued that 'excellence of character (*èthikè*) is the result of habit (*ethous*)'.[22] In his statement, he plays with variations of the word *èthos* and connects them with related terms like character and personality. It follows that doing good is being excellent and being excellent is only possible because of good habits. In order to develop good habits now, it is necessary that reason persuades the irrational part of the soul and makes it obey.[23] This mechanism, which

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21 Peter Sloterdijk, *You Must Change Your Life; On Anthropotechnics,* trans. Wieland Hoban, Cambridge: Polity Press, 2014. Or: *Du Musst dein Leben Ändern; über Anthropotechnik,* Frankfurt am Main: Suhrkamp Verlag, 2009.

22 Aristotle, *Ethica: Ethica Nicomachea*, trans. Christine Pannier and Jean Verhaeghe, Groningen: Historische uitgeverij, 1999, p. 55.

23 Aristotle, *Nicomachean Ethics,* trans. W.D. Ross, Stilwell, KS: Digireads.com Publishing, 2005: I, 13 - II, 1.

I referred to above as 'governing yourself', can only become a character trait by training. As a result, the ancient Greeks understood *èthos* (ethics) as a set of practices meant to develop good habits, but also more broadly as a capacity for action and a moral resilience. The result of these practices is the excellent and good personality that – we would say today – knows how to take care of nature and how to be polite to fellow humans.

The Latin concept for good and excellent behavior is *habitus*. Etymologically it derives from *habēre*: 'having' – hence 'habit' also for something annoying yet fixed – and the frequentative *habitare* or 'dwelling'. In various modern languages, there is an intrinsic connection between 'dwelling' (to habit; habiter), 'habitude' or 'habit' (French: habitude and habitudes: 'tradition, morals'). Along this path, too, we arrive at a point where the practice-based transformation of habits – until they have become part of our character – is an ethic. This ethic, however, sincerely differs from obeying tables of rules that are prepared by others. In the first place, it is an activity, a training scheme, hence the expression: *ethical practice*.

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Back to the Basics: Or Why [Design] Education Is Going Back to Making

Serena Cangiano

BACK TO THE BASICS: OR WHY [DESIGN] EDUCATION IS GOING BACK TO MAKING

SERENA CANGIANO

In the last few years, design has experienced what might be termed a crisis of cross-pollination. Driven by innovation at any cost, design education and the broader design community have been spliced into every facet of business, creating a storm of multidisciplinarity, interdisciplinarity, and most recently anti-disciplinarity. The worldwide adoption of design thinking and all its derivative companions, from open innovation methods to circular design canvases, have steered designers into a transition in which their practice has been lifted from design craft to the more intellectualized realm of effective problem-solving strategies.

Design has gone beyond the practice of merely crafting an object, a graphic, or a wooden stool. Today, it seems that design is finally free. Light and intangible, it has become a material-free discipline. Furthermore, due to the growing interests of companies to obtain the status of design-led organizations, design has been forced to release its inner code, reencoding itself into highly reproducible, step-by step formulas. Essentially, design is making itself accessible to the masses as it did during the first and second industrial revolution. Although intangible, design remained reproducible, fulfilling the needs of different contexts such as business schools or the third sector of non-profit organizations.

Design is no longer related to making things. But while we all agree this has been a great achievement, a sense of discomfort is growing towards this new status within the community.[1,2,3] Can we claim that the 'post-post-it age' has officially started? Or, thanks to the expressive opportunity offered by technology, are we witnessing instead the beginning of a sort of digital renaissance in which designers stand up for their rights and manifest their will to go back to the basics of making and creating things? In this article I explain the practical correlation between design and creation through personal reflections of design and design education. These reflections come from ten years experience designing hands-on workshops and master courses, where prototyping with code and hardware was the main teaching method. I will discuss the idea of value and the return to making in design through historical and contemporary case studies. These examples allow us to speculate what a learning toolkit of the post-post-it age might look like. It will probably not feature canvases or user journey maps, but instead focus on basic design exercises. Exercises like these might help everyone – not just design students – to make things that move, think, communicate, sense, see, compute or augment.

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1 Natasha Iskander, 'Design Thinking Is Fundamentally Conservative and Preserves the Status Quo', *Harvard Business Review,* 5 September 2018, https://hbr.org/2018/09/design-thinking-is-fundamentally-conservative-and-preserves-the-status-quo.

2 Natasha Jen, *Natasha Jen: Design Thinking is Bullshit*, 99U Conference 2017 on Vimeo.com, August 2017, https://vimeo.com/228126880.

3 Bruce Nussbaum, 'Design Thinking Is A Failed Experiment. So What's Next?', *FastCompany*, 5 April 2011, https://www.fastcodesign.com/1663558/design-thinking-is-a-failed-experiment-so-whats-next.

Antiprimadonna is one of the basic design exercises created by Thomas Maldonado, designer, design theorist, and revolutionary lecturer at Ulm Hochschule für Gestaltung.[4] The exercise requires design students to place seven drawings on a vertical rectangle measuring 10 x 35 centimeters and divided into seven columns. Five drawings should be full color, while two drawings should be black and white only, black lines, white dots, and so on. The goal is to avoid having any one drawing that achieves visual supremacy; none of them should dominate the others. This exercise teaches students how to define perceptive hierarchies and how to guide the viewer's eye to what is important. *Antiprimadonna* is a propaedeutic activity, it is about learning design before designing. Together with other basic design experiences[5], this toolkit allows students to develop a codified system of design principles. Such learning is highly embodied, generated through a practical activity that implies conversations and reflections, a praxis.

Let's time travel from the 1950s to the 2000s. In 2009 I attended my first Arduino workshop at i2A in Switzerland, the summer venue of the Los Angeles based architecture school SciArc.[6] The workshop tutor was a member of the Swiss Mechatronic Art Society.[7] During that workshop I had the chance to learn one of the basic principles of digital electronics prototyping: how to control a light emitting diode (LED) with a light sensor. By writing a few lines of code, I could control when the diode light was on or off and I could set a delay to make it blink or react to the value coming from a light sensor.[8] Thanks to this first step into Arduino code, I realized that programming the LED blink rate or brightness were both basic design exercises that taught the fundamentals of interactivity. These exercises dealt with core elements such as input and output, interface and feedback. Since the time of that workshop, and even after ten years of developing hands-on tech workshops for designers and artists, I have to admit my technical skills have not really advanced. But more importantly, my understanding of how to design interactive systems in a context of constant technological change is solid. Through the simple configuration of the shape and color of a light, these exercises illustrate how design education uses making activities as a way of accessing and creating abstract knowledge.[9]

Designers Under Pressure

We live in an age of resource scarcity. Design as merely the configuration of forms (Italian translation of *Gestaltung*) will not be enough to face today's big challenges and save the world. Design as a prospective act or a plan (the English language meaning of design) can instead enable designers to focus on processes rather than results in order to face the complexity of our times. Rather than designing 'products', we need to finally celebrate designing 'for a purpose'. Here, design becomes reframed. As design research duo Elizabeth Sanders and Pieter

4 Bernand Bürdek, *Design: History, Theory and Practice of Product Design,* Basel: Birkhäuser Architecture, 2005, p. 111.

5 Giovanni Anceschi, *Basic Design, Fondamenta del Design,* 2011, https://issuu.com/giovannianceschiteoria/docs/2.1-basic-design-fondamenta.

6 SciArc, Southern California Institute of Architecture, www.sciarc.edu.

7 Swiss Mechatronics Art Society, www.sgmk.ch.

8 'Blink', *Arduino.com*, https://www.arduino.cc/en/tutorial/blink.

9 Anceschi, *Basic Design.*

Jan Stappers assert, visual communication becomes design for experiencing, interior design become design for emotions, urban design become design for transformation, and so on.[10] In this transformation process, theorist Arturo Escobar highlights that designers are asked to stop making crap and start designing for the *pluriverse*, considering not only human factors but also the entire living ecosystem.[11] Paola Antonelli asks designers to design an elegant end of the world and new fictional scenarios that help humanity to reflect on and anticipate the future.[12]

Designers are under pressure. Society is urging them to use user-centered methods for development or transformation strategies. Industry is demanding that they become new innovation leaders. Policy makers are badgering them to prototype large scale changes. For a decade, the design community has constantly been under pressure to achieve the right kind of scientific acknowledgement. It no longer sounds strange when John Maeda, the American technologist and manager at the digital firm Autommattic, stated that designers have become so important that they now need to step back.[13] Following these pressures, design education has had to adapt, abandoning basic design exercises and developing new ways to transfer new design knowledge. User journey maps, scenarios, personas, ethnographic research, and design fiction stories are the tools that help young students to operate in this complex world, to learn how to think user centered and community centered, to convince companies of the value of design beyond form, function, and aesthetics. Yet despite all of this disciplinary (re)evolution, technology seems strangely relegated to the borders. Technology and design have long been in conversation, but oddly, when it comes to the education context, technology has been completely underutilized.

The Contribution of the Maker Movement and FabLabs

From 2005 onwards, maker movement's influences started entering design schools through the backdoor. 'Everyone is a maker' is its motto, and DIY and open source hardware is its tool to change the world, from manufacturing to innovation. The maker movement once again ennobled the act of building things and the domain of physical goods production. It celebrated the use of hardware and software technology as a means of empowerment by opening the exclusive domain of the model-makers to everyone. With its Arduino boards and 3D printers, the maker movement started pollinating all education sectors and levels. From elementary schools to universities, the maker movement placed prototyping and making at the center of every possible learning experience.

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10 Elizabeth Sanders and Pieter Jan Stappers, 'Co-Creation and the Landscape of Design', *CoDesign* 4:1 (2008): pp. 5-18.

11 Arturo Escobar, *Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds,* Durham: Duke University Press, 2018.

12 Antonelli and Alan Tannir (eds), *Broken nature: XXII Triennale di Milano*, Milano: La Triennale di Milano Electa, 2019: p. 23.

13 John Maeda, 'In Reality, Design Is Not That Important', *FastCompany*, 15 March 2019, https://www.fastcompany.com/90320120/john-maeda-in-reality-design-is-not-that-important.

Along with the maker movement, another key initiative contributed to education's return to making: FabLabs. This global network of fabrication labs reinvigorated learning by doing, replacing the dusty model-making labs of design schools with shiny digital fabrication machines and open knowledge platforms. Both the maker movement and the FabLabs network augmented the practice of making things by adding the technological layer and by facilitating the return to craft in the context of a digital renaissance. Key within this process is the ability of web platforms to distribute open resources. From web tutorials and programs to open sourcing the means of production, online openness made digital making accessible and affordable to everyone. It enabled a new generation of creative coders, machine inventors, and designers to rediscover the value of making as an effective way of learning and expression. Openness is the difference between the makers and designers of our time and their grandmas and grandpas at Ulm. Making as empowering reinforced this difference – suddenly anyone, regardless of educational background, could learn how to develop a product and a device.

Technology Education for Designers and Creatives

There were moments between 2011 and 2016 when I truly believed that – in Europe at least – the narrative of makers and FabLabs had completely replaced the narrative of designers. Participatory design, co-design, sustainable design, interaction design, design for manufacturing – all these fields became absorbed by the maker revolution, assimilated in its unstoppable rise. The revolution remixed them, making them understandable to the families, kids, teachers, CEOs and marketing managers who visited Maker Faires all around the globe. At that time, events, academic conferences, panels, and doctoral dissertations were all populated by discussions about what makers do, where they intervene, what their skills are, and how their work might engage with the competencies and perspectives of designers. In this comparison, makers were always the ones bringing openness, disciplinary inclusion, and more importantly, a high level of technological awareness that their polytechnic intellectual cousins, the designers, had long tried to leave behind in their pursuit of strategic positions. It was a period when both elite design universities and small design schools began working on models to introduce digital making into their curricula, catering to students who were starving for technological knowledge.

While design education tried to renovate itself by reintroducing making (or totally refusing it), design students were populating Makerspaces and FabLabs or enrolling at new programs that managed to integrate the technological factor into the creative process. The School of Machines, Making and Make-Believe is an initiative founded in Berlin in 2014 by Rachel Uwa. Their mission is to reimagine education through hands-on learning programs combining art, design, and technology.[14] In the last four years, the School of MAA has run hands-on workshops on the Internet of Things, machine learning, and an array of other technical subjects that should matter to the 21st century designer. More than a school, the initiative can be considered an artwork or a prototype of what design (and art) education could become if the separation among disciplines would finally be overcome.

14 School of Machines, Making and Make-Believe, www.schoolofma.org.

At the same time, on the other side of the Atlantic, Zachary Lieberman, a designer and developer based in New York, poured his time into establishing the School for Poetic Computation (SFPC), a six week program on design and technology for artists and designers.[15] At SFPC, students may be asked to code old analog designs alongside art pieces. As in the Renaissance period, their training is based on the observation and replication of masterpieces, but with the application of coding as a humanistic technique. In the south of Italy, La Scuola Open Source provides a hackerspace format that combines the typical maker education offer (i.e. courses on laser cutting, CNC milling, Arduino) with classes on computational typography or co-design. All these independent schools try to integrate design and technology into a practice-based education in which making and coding are not just new brushes but a new way of thinking.[16] While none are perfect, they nevertheless function as prototypes for critically discussing why and how design education should not refuse the technological factor. Rather than making as nostalgia, they see making as the only way to overcome disciplinary pigeonholing, a way to develop multiple competencies and move education towards something new.

Why 'Back to Making' does not mean Back to Chairs

In the field of STEM and maker education, educators and researchers focus on the opportunity to develop key 21st century skills like creativity and complex problem solving rather than just digital literacy.[17] FabLabs and Makerspaces, with their low-cost and easy to use soft-hard prototyping tools, empower educators to implement constructivist learning environments in which they act as facilitators of personalized and collaborative learning experiences. Within this context, it emerges that digital making – a diverse range of activities through which students learn by making an end product with a technical and creative approach – can become a way of improving education.[18] By creating a real solution to a real problem, students become engaged in a more immersive learning experience. Within education, making goes beyond making, becoming a strategy to train people to become active, responsible, and engaged citizens rather than skilled software developers.

This accent on a holistic pedagogy with making and critical thinking at its heart is not far from ideas generated in historical design experiments. Between 1973 and 1975, a collective of artists, designers, and architects that included Ettore Sottsass founded Global Tools in Italy. This multidisciplinary program aimed at deconstructing education, striving to free the individual's creativity from every kind of cultural, social, and technological constraint. The magazine *Casabella*, directed by Alessandro Mendini at the time, spread the ideas and educational formats that were ideated by the collective. Mostly they promoted a return

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15 School for Poetic Computation, www.sfpc.io.

16 Serena Cangiano,'Coding as a way of thinking Interview with Casey Reas' in Serena Cangiano, Davide Fornari and Massimo Banzi (eds) Open Technologies [special issue], *Progetto Grafico* n.30 (Autumn 2016), pp. 20-30.

17 Chris Dede, 'Comparing Frameworks for 21st Century Skills' in James Bellanca and Ron Brandt (eds) *21st Century Skills: Rethinking How Students Learn,* Bloomington, IN: Solution Tree Press 2010, pp. 51-76.

18 Carmen Bruno, Giuseppe Salvia, Marita Canina, 'Digital Making as a Means to Improve Education', *Proceedings of INTED2016 Conference*, 7th-9th March 2016, Valencia, Spain.

to the authenticity of manual work. According to Global Tools, education had to stimulate an awareness of the structure of society and in particular, society's use of the education system to perpetuate constraints on individuals.[19]

Fascinated by autarchy and materials, the Global Tools program included several research tracks such as the Construction track theorized by Andrea Branzi. In one note describing the laboratory, Branzi talks about the use of a 'simple technology' as a way of zeroing in on the artificiality and the intrinsic perspective of every tool. For Branzi, simple technology is material that has been purified of the cultural baggage and predefined concepts that are normally attached to technologies. Situated in Branzi's broader pedagogy, simple technology was an expression of radical thinking in education. Unfortunately, the radical thinking of Global Tools failed after two years of experiments. However, I believe that the concept of simple technology is somehow reenacted in the current practices of digital making, open hardware, and design applied in education. In this context, simple technologies are the open codes, electronics and designs that work as materials to make almost anything without any disciplinary barrier and with a critical perspective. The simple open technologies of digital making-based education empower students to be in control rather than be controlled. Instead of being taught to create another chair, students are taught the mindsets and skills necessary to face the vast societal challenges of today.

Like the designers and artists of Global Tools in the seventies, we too are living in a period of dominant power, yet one that takes the form of a digital panopticon able to shape people's behaviors and lives. As a consequence, the return to making (with a digital perspective) is no longer a nostalgic action, but a survival strategy. How can we design for a contemporary context if we do not understand how its main material operates? To design for this context, we must learn how to decode and deconstruct the power embedded in everyday technologies. To do so, we must step through a basic process of making that enables us to critically decide how we want our contemporaneity to be built. From this perspective, the return to making in education does not mean stripping out complexity and reducing the role of thinking in the design process. Instead, it suggests that schools are prototypes to validate – before releasing the final solution – the possible ways to contribute to any societal change. Within these prototypes, students should be exposed to updated 'libraries of simple open technologies'. By removing the filters imposed by the private titans of the technological sector, such libraries would enable students to critically include their own perspective as responsible and engaged citizens.

In a 'post-post-it' society, I wonder what the ultimate design toolkit to train the 21st century designer could be. Rather than the usual canvases or user journey maps, this toolkit would feature a set of basic design exercises that help everyone, not only design students, to make things that move, think, communicate, sense, see, compute or augment. These exercises would help students to control technology, to assertively own it as a material, a tool, and a key factor influencing society today.

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19 Valerio Boronuovo and Silvia Franceschini (eds), *Global Tools 1973-1975, When Education Coincides with Life*, Rome: Nero, 2018, p. 39.

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Learning the Washing Machine

Samantha Penn

LEARNING THE WASHING MACHINE

SAMANTHA PENN

This text documents the practice-led research project *Learning the Washing Machine*, which investigates what can be learned about machines and culture from working with home appliances, specifically washing machines. Our relationship with our washing machine housemates is intimate, but the way we talk, think about, and interact with them is restricted by a variety of interconnected structures. Years in the making and involving varying extents of monopolization or diversity, these structures are built by humans and machines together, and maintain morals, success, knowledge and identity to materials, machines and systems of symbols. The project is an attempt to 'learn washing machines', and in the process to work out what it means to do so.

This project was developed as a continuation of discussions around computation and culture that myself and other project collaborators had while undertaking the MA in Digital Culture at Goldsmiths University's Centre for Cultural Studies. It is particularly influenced by the work of YoHa, whose work contributes to the growing field of Critical Technical Practice, originally coined by Phil Agre.[1]

The workshops documented here explore one or a small number of processes, stories, activities, or other threads linked to washing machines by exploring a process of group laundry, dismantling washing machines, studying and remaking wash cycles, and tracing water system timelines. They look at what washing machines do and have done, how they came to exist, and the larger and smaller scale (social) cycles and routines they are part of.

Group Laundry

In this workshop a large group of people split into two smaller groups to do laundry. Each group washed clothes while observing the apparatus, discussing the processes they were using, and making decisions as a group about the laundry. One group used a washing machine and detergent. The other used a bowl and handwashing soap, washing clothes by hand.

The workshop was informed by age-old community laundry practices. Formal records exist from the 1600s (though the practice has existed for much longer), documenting areas of grass, bushes, or built structures set aside for the communal drying of clothes, and the practice of washing clothes in groups by the river.[2] Both groups remarked that washing is something they usually do alone. Washing today usually is solitary. We discussed the implications of today's practice of washing in solitude, isolated from others and isolated from an understanding of washing machines and the washing machine industry. How does this solitude affect the way people think about self, community, engineering, and industry?

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1 Phil Agre, 'Computing as a Social Practice', in Phil Agre and Douglas Schuler (eds) *Reinventing Technology, Rediscovering Community: Critical Explorations of Computing as a Social Practice*, Greenwich, CN: Ablex Pub, 1997, pp. 1-19.

2 Lel Gretton, 'History of Laundry', *Old and Interesting*, 2010, http://www.oldandinteresting.com/history-of-laundry.aspx.



Fig. 1. Samantha Penn. Group washing with PACTO at Bark, Athens, 2017, image by Nora Silva[3]



Fig. 2. Samantha Penn. Group washing with PACTO at Bark, Athens, 2017, image by Nora Silva[4]

3 Image reprinted with permission of the photographer.
4 Image reprinted with permission of the photographer.

The group working with the washing machine noted that the settings on the machine suggested materials to work with (wool, delicates), and wondered how the settings had been chosen. In the discussion following the workshop, we talked about the relationship between washing and data. Market researchers interview people about their laundry habits, and these responses inform the marketing and distribution of detergents, as well as the design and engineering of laundry-related products.

Workshop participants reported being unaccustomed to thinking about laundry as a process, or to linking it to science or engineering. People also reported being more aware of their bodies and of actions and decisions than they usually would when washing. Washing in a workshop format brought up previously unarticulated associations with work, study, and public events, and awareness of different people's washing routines. The groups came up with strategies for washing in response to the unusual situation they were working in. For instance, one group combined handwashing with a ball game to throw balled-up socks into water. Another group stood around the washing machine and watched each other demonstrate how they put their washing into the machine – after this quick review of techniques, the group collectively chose one to continue with.

Laundry tends to be placed in the realm of a particular kind of work, 'house work', which is neither linked to science and engineering, nor to study. Responses to the group washing task reflected this – several people in both groups resented having to 'do work' when they had expected to 'do a workshop', and some found it difficult or uncomfortable to think about something usually carried out on 'autopilot' as a workshop. The workshop also seemed to express something of the way washing machine history has affected relationships between work and gender – the broadly female group seemed reluctant to be exploratory with washing routines and worked in a speedy and considered way, while the broadly male group turned washing into a game, but didn't engage much with the group analysis and discussion of washing. Exploring practices of doing laundry inevitably provokes us to consider ideas around domestic labor, which is historically a gendered one. Of course, this one-off workshop is neither representative nor conclusive; it is a discussion about laundry carried out while doing laundry. It would be interesting – but still inconclusive – to repeat the workshop in different contexts in order to understand how both our relations to washing and washing technologies themselves might be gendered today.

Dismantling the Washing Machine

This activity involved dismantling washing machines. Three groups of people dismantled three machines with hand and power tools, looking at and handling the parts, researching the parts to find out what they did and how they related to one another, and physically laying them out on the ground. Each of the dismantling sessions was followed by a discussion. Most of the people who dismantled washing machines had no prior training in engineering, so we relied on the collective knowledge of the group to find our own routes into thinking about the machines different components and operations.



Fig. 3. Samantha Penn. Dismantling washing machines, group workshop at MACAO, Milan, 2017, image by Nora Silva.[5]

Broadly speaking, those whose daily life involves working regularly with their hands were confident, while those unused to working with their hands held back. When asked about this they said they were intimidated by something they read as unfamiliar, and even dangerous. Some people were unfamiliar with tools – one person while dismantling a washing machine said that they didn't know how to hold a spanner – that it felt uncomfortable in, and slipped from, their hands. Others telling them how to hold the spanner was helpful, but they were still relatively slow, and therefore held back while other more confident people dismantled most of the machine. Another person said they didn't know where to start when taking the machine apart; they didn't know how to think about how the parts fit together or how they could be taken apart. A third said that they built their sense of identity and success around writing and working with people, and felt useless and vulnerable with the washing machine. They felt that it was too late to start to learn how to work with machines. Such responses show that although the washing machine is a ubiquitous object most people are familiar with through everyday use, it remains somewhat mysterious. They also show that how a person relates to the washing machine is heavily linked to the skills, knowledge and experiences they already have, as well as their relationship to others dismantling the machine.

Dismantling the washing machine began with touching and looking. We could not hope to 'understand' washing machine parts, but we could indeed touch them, feel their weight, blow

5 Image reprinted with permission of the photographer.

into them, spin them, make visual readings of them, ask questions about them, look them up in washing machine manuals[6] and watch videos of them working or being repaired.

Washing machines are made of structurally similar, but specifically tailored, components – for example, the motor which spins the drum and the motor in the pump. Remove one part, and the machine stops working as planned, since all the other parts rely on it. This is specifically the case for older machines. With newer machines, however, when a part stops working as programmed, the cycle continues regardless (resulting in clothes being more soapy or wet than usual). This makes troubleshooting more difficult, but nevertheless still possible.

Many workshop participants found it challenging to think about how the parts work together. This was especially the case when it involved reading circuit boards or thinking about the interaction of components, when not used to doing so. People found the relationship between the motor and the circuit board, the solenoid valve, and other parts obscure. They reported difficulty reading the symbols on circuit diagrams, or working out how to research washing machine parts from serial numbers (when information on a component is found online, references to it are usually in technical datasheets or sales listings). The difficulty people had in approaching datasheets is not surprising given the years it takes to become an engineer, as well as the general separation of industrial work from housework (something we explored as part of the LED sequences workshop below). Strategies readily available to anyone without training – such as feeling and handling the machines' parts, following the routes of wires or pipes, and looking up manuals and tutorials – were techniques for approaching the washing machine that somewhat addressed these difficulties. It also helped to take time over the dismantle, to make a social event of the activity. Group washing has historically had the extra function of cementing relationships in a community. Group dismantling, like group washing, demands time and space away from routine spaces and habits in order to stand and scratch heads, collectively agree on an approach, and pursue it methodically, and can therefore act in a similar way.

LED Wash Cycles

This activity began with research into the history of washing machines from two angles. The first explored the history of the mechanisms used to wash clothes (such as washing bats and beetles, dollies, washboards, hand turned 'tombola' style drums, dollies raised and lowered by a crank, or drums turned by steam engines) as presented by Lee Maxwell[7] and Lel Gretton.[8] The second angle comprised the history of the development of domestic appliances during the industrial revolution in the UK and US, specifically their role in redistributing domestic work, as demonstrated by historian of technology Ruth Schwartz Cowan.[9]

6 Graham Dixon, *The Washing Machine Manual.* Somerset: Haynes Publishing Group, 1999.
7 Lee Maxwell, '*Oldewash: Agitator Alley',* Washing Machine Museum, 2013, http://www.oldewash.com/agitator_alley/agitators.html.
8 Lel Gretton, 'History of Laundry', *Old and Interesting*, 2010, http://www.oldandinteresting.com/history-of-laundry.aspx.
9 Ruth Schwartz Cowan, *More Work For Mother: The Ironies Of Household Technology From The Open Hearth To The Microwave,* London: Free Association Books, 1989.

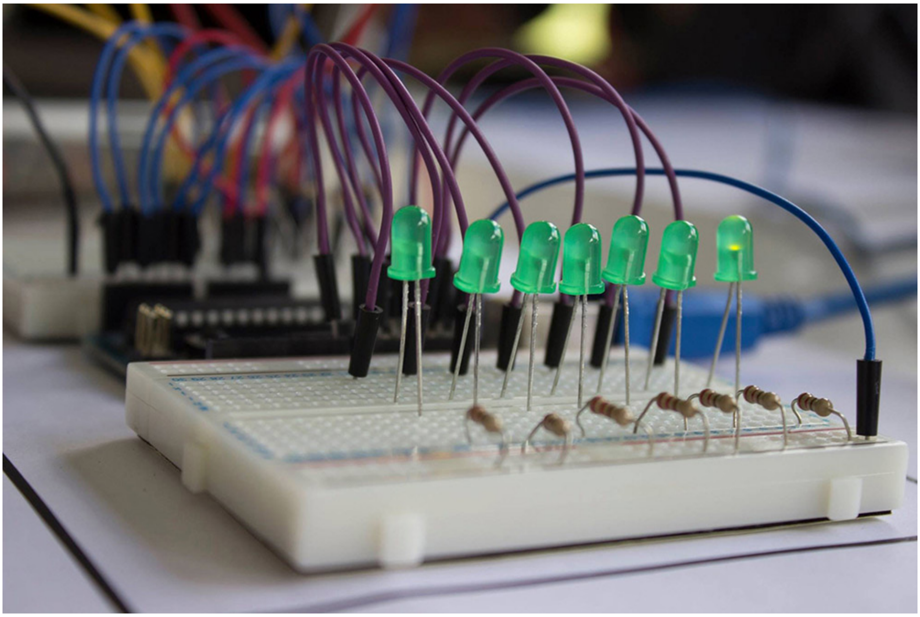


Fig. 4. Samantha Penn. Washing machine sequences as LEDs, Goldsmiths University, 2017, image by Eleanor Chownsmith[10].

This research informed the values attached to the LEDs in sequence. A number of LEDs arranged in a parallel circuit were programmed to light up for specific durations. For the historical timeline, one second of illumination represented one century, and each LED represented a different mechanical means of washing clothes. For the wash cycle timeline, each LED represented a washing machine component, and one second of illumination represented one minute.

During a series of workshops, the LED cycles were laid out on tables. People taking part could select and run a washing machine history sequence by completing one of seven LED circuits. Participants could also make a timeline of their daily wash routine and, if they had time, set up a circuit of their own.

The story of laundry is complex and largely undocumented. This is perhaps because laundry was historically done by working people, often women with families – people unlikely to have read and written or be written about on a regular basis. Today, dynamics are different: washing machines can be found in the homes of journalists and historians, but historic dynamics have arranged infrastructures and practices in such a way that washing machines are rarely mentioned. As such, our understanding of them is based largely on physical interactions.

The way people do laundry is also highly contingent on local knowledge and conditions. Laundry routines involve planning, thought and skill. Doing the washing involves making a great number of small decisions.

10 Image reprinted with permission of the photographer.

LED	Represents	Century	Seconds
1	Hands, feet	30th BC	30 + 19 = 49
2	Washing bats and beetles	25th BC	25+19 = 44
3	Ships	10th BC	10 + 20 = 30
4	Washboard, dolly, posser	17-19th	3
5	Hand operated rotary, pivot-tilting, scrubbing devices	18-19th	2
6	Motorised dolly, pounding plunger, tilting on pivot, washboard etc	19th	1

Fig. 5. Samantha Penn, LED sequence 2: washing machine agitation styles, 2017

There is a great variety of uses of laundry baskets, approaches to collars and cuffs, approaches to hanging and drying clothes and spaces and conditions appropriate to do so, and ways to add detergents to washing machines. There are also a variety of ways in which machine manufacturers name their wash cycles (what the chosen names say about washing machines and how they are made is a pressing question and warrants further research).

The LED sequences communicated aspects of the particular relationship between washing machines/laundry and time.Throughout its history, laundry has involved alternation between the focused and frenetic human-led activity of washing, and pregnant pauses – periods of waiting for important processes such as drying or soaking to take place. In recent decades, electrical washing machines have contained most of this activity inside a box. This doesn't mean that the durational character of doing the laundry is hidden; it is just arranged differently. The durational character of washing machines is evident in the motor spins and pauses between them, in the click of the door interlock mechanism, and in the gradual turn of a dial or the flashing of LED lights. During the LED sequencing workshops, participants had to wait for each LED to light up, marking a significant point in the history of washing machines. Sometimes a light would stay on for 20 or 30 seconds. The experience of waiting to read the history of washing machines in lights echoes that of waiting for a cycle to finish. It is also important to note that the LED lights on a washing machine are one of the signals – beside listening and checking the door – that people often refer to when making sure the wash sequence has ended. (Question for a future workshop: how would people relate to a washing machine history made with motors or valves?)

To make a history in lights necessitates deciding on a limited number of historical events to allocate lights to. Using LEDs to represent historical patterns truncates the complicated story of washing machines. This is problematic from a historian's perspective, as selecting a small number of historical events or markers erases countless others. It is less problematic from a washing machine learner's perspective, as the replacement of detail with representative markers has similarities with the way the washing machine

chip is programmed. These are some of the insights we had when talking about the LED history sequences. The story of washing machines is bound up with the story of motors, drums, valves, suspension systems, and programmer chips.

```
//washing_machine_cycle (LEDs represent parts of wash-
ing machine.
//Duration LED is lit roughly represents duration part
is working)

//LED1 Door Interlock
//LED2 Solenoid Valves
//LED3 Thermostat
//LED4 Heating element
//LED5 Pressure switch
//LED6 Motor
//LED7 Drain pump

//START OF SEQUENCE

void Sequence(){

    digitalWrite(LED1, HIGH);
    digitalWrite(LED2, HIGH);

    //thermostat tests water - hot enough? N
    digitalWrite(LED3, HIGH);
    delay(1000);
    digitalWrite(LED3, LOW);
    delay(1000);

    //heating element on
    digitalWrite(LED4, HIGH);

    //thermostat tests water - hot enough? N
    digitalWrite(LED3, HIGH);
    delay(1000);
    digitalWrite(LED3, LOW);
    delay(1000);


    [...]
```

Fig. 6. Samantha Penn, LED sequences, code snippet, 2017.



Fig. 7. Samantha Penn, Water system timeline, 2018.

Water System Timeline

For this activity, students and staff at Goldsmiths (University of London) built a network of pipes which was also a timeline communicating washing machine history. The pipes were copper soldered 15mm and 22mm plumbing pipes, plus one 28mm MDPE pipe, fed via a four-gallon cold water tank typically used to feed a central heating system and to condense and collect excess steam. A washing machine water pump was used to keep water flowing around the system.

As with the LED sequence timeline, this timeline articulates the washing machine as a networked machine. The copper and plastic pipes used to make the timeline are standard in UK domestic plumbing; the copper pipes supply water, while the plastic pipes carry away waste water. In most homes in the UK, the washing machine is connected (via washing machines valves and pipe connectors) to these pipes, which in turn are connected to the mains pipelines that connect towns and cities with reservoirs, sewers, and water treatment plants. The history of these pipes is woven into the history of cities and towns. Pipes, tanks, and radiators are the most recent in long, tangled lines of components and systems designed over thousands of years to contain and distribute water, to deliver water to homes and workplaces, to remove waste water, to put out fires, to manage building temperatures, and to keep dirty and clean water separate. Plumbing systems in the home have been refined over centuries, (a good example is the history of the boiler and the various safety and fuel-reuse measures added over the years), yet some of the skills and practices carried out by plumbers today echo those carried out thousands of years ago. Soldering copper pipes, the use of controlled sources of gas to heat water, and gravity-fed plumbing systems have existed in some form or other for millennia.[11] By incorporating parts from domestic plumbing systems, this timeline made from pipes – as with the LED sequences – references some of the

11 Carter Hodding, *Flushed: How the Plumber Saved Civilization,* New York: Atria Books, 2007.

components that activate washing machines and laundry activity, thus building links between the components and the history of laundry. The hands-on activity of collaboratively building the system also communicates washing machine history and identity. Here, the hands-on work of the plumber and the laundress are connected at the point where water leaves the pipes and starts to fill the washing machine.

As much as the existence of washing machines provide a baseline for the cleanliness and effort we expect in relation to laundry, plumbing systems provide markers of expectation linked to water provision, cleaning and storage. A water pipe leaking in the home is distressing because it threatens many of the security systems we build around ourselves, raising red flags around hygiene, the structural stability of the materials homes are made from, money, and the entry of a stranger into the home. A plumbing emergency reminds many homeowners of their lack of practical ability, and by extension, their vulnerability in a crisis. Plumbing systems are part of infrastructures contributing to longer lives and lower disease rates. They are usually reliable and in many ways make life simpler. They are also a way for governing bodies to maintain and exert power - through allocation and withdrawal of water maintenance, through the establishment of standards of hygiene and technical complexity attainable only to some, through the construction of rigid physical boundaries, structures that both keep us safe and trap us in rituals.

One of the reasons plumbing, laundry, and washing machines have been little written about is that writing isn't particularly useful in these areas. The only way to learn the 'language' of water systems or electrical systems or mechanical systems is to be within them, to work within them. It is interesting that the way many washing-machine-housemates and even more so computer-housemates interact with their machines in the UK is via a narrow group of repetitive actions involving buttons, cable connections and switches, whereas simultaneously, the physical footprint of these machines is so massive, involving digging up of land, the efforts of thousands of people, the pressure of gallons of water, and so on.

Conflations, Separations, Restrictions, Agitations

Washing machines agitate clothes, conflating soap, dirt, fabric, and hot water, separating clean and dirty water, and types of fabric. These conflations and separations are linked to the production of other conflations and separations outside the washing machine drum. For example, the processes which led to the arrival of the washing machine motor are linked – via the Industrial Revolution – to the process of separating the house-bond (husband[12]) from the house-wife, separating the home from industry, and separating people into two genders whose actions are restricted by complicated regulatory systems. Another example: the manufacture of copper wire or copper pipes is connected to the Industrial Revolution and to colonial practices of consolidating power by moving difficult, dangerous, and scarring work from one country to another. Similar regulatory systems evolved separating the word 'work' along various lines; work as a social phenomenon is separated from work as a physical one. Work as a social phenomenon is further fragmented in numerous ways. Construction work,

12 Ruth Schwartz Cowan, *More Work For Mother,* p. 17.

office work, academic work, and house work is one fragmentation framework that evolved due to physical separations and logistics. Another framework separates thought from action. Another separates science, engineering and culture. Another separates digital from analogue. Washing machines connect these fragmentations, but we are not used to thinking about the fragmentations through washing machines.

- Here are some examples of the separations and conflations whose existence the washing machine project has so far indicated:
- Housework is disconnected from industry/engineering/science, despite the two having co-evolved.
- Through industrialization, bureaucratization, and computation, people are separated along lines of gender and class.
- The concept of work is often separated from the concept of learning (hence the repeated question 'why are we doing a workshop on washing machines?').
- Machines and their industrial production are separated from, and thus infrequently recognized as part of, 'the cultural' and 'the social'.
- The concept of knowledge is disconnected from housework.
- Systems developed away from the home, in factories, are infrequently mentioned in the home despite their daily presence within it.
- Housework evolved to integrate home appliances, but is not concerned with repairing them or understanding how they work. These problems were historically, and still are, dealt with in factories and by occasionally-visiting engineers.
- If domestic appliances (which replaced servants) do not work properly, a family loses a resource important to harmonious survival, therefore risking decline in social status, and by extension, wealth and stability.
- Housework is linked to the maintenance of lifestyle – it is unpaid but indirectly monetized.
- Morality is conflated with cleanliness.
- Health is linked to adherence to social rules and to success and wealth.
- There is only limited crossover between two related realms: the work done by house-keepers and washing machines, and work as studied by physicists and integrated into the design and construction of washing machines.
- The social influence of both washing machines and laundry are assessed following psychological methods and principles, and organized for processing by search engines and social media.
- The social influence of laundry is also assessed via often unspoken sequences of observations and actions. These unrecorded practices indirectly shape the lines along which people establish and police collective boundaries.
- The social influence of the washing machine is rarely, however, included in academic research or discussed in the home.
- The work of electricity and water systems is rarely discussed in the day to day running of the home unless electrical or plumbing work is done – repairs which completely and traumatically interrupt the running of the home.
- Security and stability of one system requires a reduction in security and stability of the other.

Another separation leads us to collectively distinguish between the demarcation of continuities into discrete blocks, and the continuity being demarcated. This leads to a tendency to look at either one or the other, not both at the same time – overemphasis on either the discrete or the continuous, rather than seeing both as shaping forces with interacting effects. Separation and restriction have been common practice for at least as long as humans have farmed land (building fences and other land defenses prevents cross-pollination and thus leads to more reliable crop yields). They help us to ensure we have enough resources to survive, to thrive, and even to plan ahead. Home appliances are involved in localized survival, thriving and forward-planning – as any housekeeper will tell you. At the same time, such separations are part of centuries-old and far-reaching systems which restrict and obfuscate.

The symptoms of these restrictions and obfuscations are as complicated and difficult to observe as the restrictions themselves. This project only begins to highlight some of them. Broadly speaking, the presence of machines in the home is only noticed when they break down. Repair work severely disrupts the daily running of the home; apart from the comfort provided by tea and toilet breaks, the daily routines involved in running a home and family, in turn, disrupt repair work. In industrial settings, chairs and kitchens are relied upon, but little noticed until they are removed or broken, at which point distress and disputes begin.

Infrastructures are maintained and machines run smoothly because of restrictions in specific places: conflations in some areas, separations in others. Without these restrictions, infrastructure would be visible and overwhelming. We would have to find different ways to process and handle health, water distribution, temperature control of homes (currently via hot water), and bodies (currently via clothes). Restrictions, by their very definition, deliberately obscure. By spending time with washing machines, this project begins to unravel some of the conflations, possibilities, and restrictions they produce.

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C IS FOR...?

Cards for Collaborative Learning of / for / from / about Critical Making

Verena Kuni

C IS FOR...? CARDS FOR COLLABORATIVE LEARNING OF / FOR / FROM / ABOUT CRITICAL MAKING

VERENA KUNI

What Do We Want to Learn Today? If the answer is 'Critical Making', what does that mean? If we think of Critical Making as a practice, couldn't we just jump in, learning by doing? However, wouldn't that mean that we already have an idea of what Critical Making is and how it works? So should we first learn something about Critical Making? If so – and if we want to take our original purpose seriously – shouldn't our learning process be guided by critical reflection about our subject as well? Would that mean our learning process should not so much be about finding answers, but about posing questions? If 'Critical Making' is the answer, what are our questions?

Let's give it a try. Together, let's look at practices, theories, concepts, methods, techniques, and tools associated with Critical Making to find out more. In doing so, we can examine the attitudes or stances that each adopts to Critical Making. We can see what kind of questions they claim to answer by the way they conceive, think, develop, and do Critical Making. Taken together, these should help us learn of, for, from, and about Critical Making. Thus, we could start with mapping our terrain. Based on this mapping, we can create a set of index learning cards that help us to ask our questions.

But how should we map our terrain? Obviously, we will have to do some research, and we will have to decide which methods to use. Addressing our questions directly to Critical Making practitioners would certainly be a great idea. Yet, for a variety of reasons, this option is not always available or practical. Fortunately, there seems to be a valuable alternative. In recent years, a whole body of literature has sprung up, a growing collection of publications dealing with practices, theories, concepts, methods, techniques and tools of Critical Making. So we should consider reading as a solid basis for our mapping.[1] Drawing from a variety of resources will help us to carry out a mapping that is as varied as it is detailed. It will provide us with a rich pool of possible key terms for our index, and a rich pool of materials for our learning cards.

However, even the process of conceptualizing practices should come with critical reflection, shouldn't it? What happens to seemingly neutral processes like mapping and indexing today, when we can read letters not just as language, but as a brand name of one of informational capitalism's biggest global players? What about those languages we're learning anyway? And as long as we're asking questions, shouldn't we also ask about the cards?

As these questions concern the fundamentals of our concept, we will have to explore them first in some detail before we can begin to make our learning cards. Yet in doing so, we'll find out that we are already right in the middle of processing Critical Making. Alas, let's give it a try!

1 For a suggestion of related readings – which are, for good reason, not limited to publications focusing explicitly on Critical Making as their main subject, but also include reflections on making and on criticality – see Appendix 1: Critical Making Bibliography – Critical Mapping Sources.

C is for...Cards

Why Cards? Cards have a considerably long tradition as learning tools. Most people will be familiar with a widely used sibling of index cards, the so called 'flash card'. In its basic form, a flash card comes as a rectangular piece of paper with a question or a problem on one side and the answer or solution on the other (in the case of language learning, a single word or phrase on one side and the translation on the other). Learning with flash cards is generally considered a drill that helps memorize information through active recall.[2] Obviously, this method of learning makes sense for information we would consider factual and stable (never mind that this is not necessarily always the case), and that we later want to be able to retrieve as knowledge on a subject. That's why flash cards can be helpful tools to learn vocabulary, formulas, numbers, names, terms, taxonomies, orders, chronologies, and the like. And that's why they neatly connect to established 'orders of knowledge', including ancestors of our databases like the card-based systems of the 'Zettelwirtschaft'.[3]

However, it is precisely for this reason that flashcards would probably not be our favored learning tool for Critical Making. Above all, the notion of 'critical' invites us not to take anything for granted in advance, but rather to critically reflect upon our subject, including ideas, theories, concepts, materials, tools, practices, and processes associated with it. As it stands, even the concept of Critical Making varies widely. More than a method, it is also framed as a creative approach, a reflexive practice, a tool for artistic research and design at the interfaces of media, matter and society,[4] an educational tool, and even a learning strategy by itself.[5] With this multitude of definitions, if we seriously think about learning cards for Critical Making, wouldn't we expect a different set of cards and different setups for its many uses?

Certainly flash cards are just one way of using cards as learning tools. Over the past decades, especially within the creative sectors, other types of cards have enjoyed an astonishing rise. One reason for this is the connection between learning and playing that has been recently

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2 While the basic principle refers to traditional memorizing techniques, the use of wooden or paper flash cards in educational context became popular in the late 18th and early 19th century; a prominent introduction to advanced techniques of using flashcards has been provided by the German author Sebastian Leitner in his still popular book *Lernen lernen* ('Learning How To Learn'; later editions come with a slightly different title, *So lernt man lernen*, Freiburg, Basel and Wien: Herder, 1980). Although today there is also related software, analog flash cards are still widely used learning tools.

3 See Markus Krajewski, *Zettelwirtschaft. Die Geburt der Kartei aus dem Geiste der Bibliothek*, Berlin: Kulturverlag Kadmos, 2002. Engl.: *Paper Machines: About Cards and Card Catalogs 1518-1929*, trans. Peter Krapp, Cambridge: MIT Press, 2011. We may well consider extending this perspective into the present as well and count in many contemporary uses of cards, and also the more trendy uses of sticky notes.

4 These aspects are not necessarily to be understood as coming 'all-in-one', as there are different approaches towards Critical Making, and these are focusing on different aspects and/or weigh these differently; for more details see the paragraphs below and the Critical Making Bibliography – Critical Mapping Sources in the appendix.

5 While not always explicitly discussed, this aspect is embedded in the methodological approach of the way Critical Making is introduced in many core publications on the subject; see i.e. Rosanne Somerson and Mara L. Hermano (eds) *The Art of Critical Making. Rhode Island School of Design on Creative Practice*, Hoboken: John Wiley & Sons, 2013; and obviously in this volume.

reinforced by the gamification of almost everything.[6] Other trends might be included along with these: the use of hands-on tools in human-centered, 'user-oriented' and community-oriented design processes;[7] process-oriented cards drawing from experimental and cognitive psychology, including cards used in therapy and coaching sessions;[8] and even divination systems, because they also use cards as media for thinking and making.[9] While many of these uses are not primarily about learning, certain features, properties, and conditions of them may well qualify for being adapted to learning processes. In many cases the interplay between images and words – often an important (if not decisive) part of the card design – contributes to opening up a poly-logic space for thinking and action.[10] Plus, while flash cards are usually addressing an individual learner and conceive learning as a rather solitary process, many other card systems build upon communication, and often also upon action – sometimes explicitly anticipating the application of what is being learned. And the fact that the majority of card systems – just like the majority of card games – develop and engage with a temporary community of players or participants, is another good reason why cards can be considered in particular as a tool for collaborative learning. At the same time, with regard to the different structures of the related 'communities' (obviously, a therapy session or a future telling session differ from a gameplay session, and a group of professional skat players differ from a group of friends and again from a family playing cards), just as in other learning contexts the format will always afford to address questions of power and power-related hierarchies – those embedded in the 'rules of the game',[11] those embedded in the framework of the systems it is installed within, as well as those brought in by the people involved.

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6 See Sebastian Deterding and Steffen P. Walz (eds) *The Gameful World. Approaches, Issues, Applications*, Cambridge, MA: MIT Press, 2015.

7 The most prominent example being the *IDEO Method Cards*; for more information on the cards and other 'tools' related to IDEO's Design Thinking philosophy see https://www.ideo.com/tools; for a nice overview on the subject including historical precursors like recipe cards or Brian Eno's and Peter Schmidt's *Oblique Strategies* cards, see Ola Möller, '82 Creativity Card Decks: Case Studies', 2014, https://methodkit.com/research-method-cards/; for further reading see Christiane Wölfel and Timothy Merritt, 'Method Card Design Dimensions: A Survey of Card-Based Design Tools', in Paula Kotzé, Gary Marsden, Gitte Lindgaard, Janet Wesson, Marco Winckler (eds) *Human-Computer Interaction - INTERACT 2013*, Berlin, Heidelberg: Springer, 2013, pp. 478-486.

8 Here we find a rather broad spectrum ranging from the (in)famous *Zener Cards* used by Karl Zener and Joseph B. Rhine for experimental research on ESP to Eli Raman's *OH-Cards* that are designed as visual storytelling prompters in therapy sessions.

9 It is probably not by chance that the most prominent example, Tarot Divination Cards, due to their considerably rich uses of images and/as metaphors as media for communicative processes, have often attracted artists to either create their own decks and/or use the cards as performative tools. For a recent example, see Denisa Kera's project *Parlor of Futures*, https://futureparlor.tumblr.com/. For a UX-/persuasive design related emulation-appropriation, see Meriç Dağli, 'A Critical Design Sprint Tool. The Rules of the Cold-Reading Cards', 2017, http://mericdagli.com/project/a-critical-design-sprint-tool.

10 A nice example – and one that also relates to our subject matter – is the set of *Unmaking Cards* designed by Moritz Greiner-Petter as a tool for the IXDM Critical Media Lab (Basel) and RIAT Research in Art and Technology (Vienna)'s 'conversation piece' session 'on maker and hacker culture' at *transmediale* 2016; see https://www.ixdm.ch/portfolio/unmaking-5-anxieties/ and https://www.ixdm.ch/wp-content/uploads/2016/03/unmaking_cards_web.pdf.

11 Not only in reference to games in general and their cultural significance (as explored by Johan Huizinga, Roger Caillois and others), but in our context also in reference to Pierre Bourdieu's 'règles d'art', see Pierre Bourdieu, *Rules of Art: Genesis and Structure of the Literary Field*, trans. Susan Emanuel, Stanford: Stanford University Press, 1996.

Last but not least, one more general point should be made regarding card-based learning systems. Many card systems, including method cards, come as predesigned, ready-to-use cards. But creating the cards yourself is helpful, if not instrumental, to the learning process – a strong argument for not only using cards as tools for collaborative learning, but also for considering the process of conceiving, designing, and creating the cards as part of the learning process. However, while active engagement certainly supports active learning, the quality of knowledge is also bound to the quality of information.

M is for...Mapping

Why mapping? For good reason, Garnet Hertz has proposed 'identifying core metaphors of a field' as a first step for Critical Making.[12] Due to their general relevance for cognition, concepts, communication, and culture, metaphors provide keys for understanding the ways we think, act, and communicate.[13] However, for precisely this reason, it is also impossible to escape their impact. Thus, we have to be well aware that our keys are both keys in a more literal sense, and at the same time *imagines agentes*[14] – directing us and asking for a critical reflection as well. They are both subjects/objects and tools of and for Critical Making.

Therefore, while our project is not about geography, we can draw insight from the concepts (methods, theories, practices...) of critical cartography:[15] we should also acknowledge that 'the map is not the territory it represents'.[16] Our mapping is deeply influenced by the system, the structure of thought, and language itself. Moreover, our mapping will never ever be able to cover the subject matter completely – not even approximately.

Nevertheless, mapping can be a useful step in the course of the learning process. While our primary goal is not to visualize information, in the framework of a collaborative learning process it certainly makes sense to use some simple form of visualization at least. For example, we might write the terms on cards and then arrange the collection on a wall in order to discuss them together. This would also allow us to discuss the pros and cons of different mapping methods used in learning processes. If we compare mind mapping versus concept mapping, for instance, the former can invite us to think about the relations between language and meaning, categorization and hierarchization, while the latter is probably better suited for gaining insight into the different concepts of Critical Making, and it might also help us to look for possible cross references.[17]

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12 See the references in the chapter 'P IS FOR...PROTOTYPES' below.

13 Metaphorology is a field of research with a long tradition and a vast convolute of recommendable readings; for a classic of special relevance here see George Lakoff and Mark Johnson, *Metaphors We Live By*, Chicago: Chicago University Press, 1980.

14 The concept of 'acting images' goes back to the Latin *Rhetorica ad Herrennium* and has been of influence on many theoretical approaches discussing powers and potencies of different classes of images since; there are good reasons to include metaphors in this perspective.

15 See for example Jeremy W. Crampton and John Krygier, 'An Introduction to Critical Cartography', *ACME: An International Journal for Critical Geographies* 4.1 (2005): pp. 11-33.

16 See Alfred Korzybski's much-quoted statement from *Science and Sanity: An Introduction to Non-Aristotelian Systems and General Semantics*, New York: Institute of General Semantics, 1958, p. 58.

17 On knowledge mapping methods in general see: Chaomei Chen, *Mapping Scientific Frontiers: The Quest for Knowledge Visualization*, London, Berlin, Heidelberg: Springer, 2003; on Concept Maps see:

However, as our starting point are the publications about Critical Making, and as we want to end up with a series of head words for our learning cards, we could also embrace the basic principles of semantic mapping, especially as these will also help us with the necessary reductions of our list. Because Critical Making is closely associated with technology, and especially with digital technologies, should we also think about using software? Software for text mining, for instance, would allow us not only to simply retrieve items, but also to automatically export an alphabetical list. Or should we rather refrain from automated processes, not only due to the preference for qualitative in contrast to quantitative evaluation,[18] but also due to the fact that we are aiming to learn of, for, from, and about Critical Making – and thus should bet on human brains and close-readings, rather than relying on machines to do the work?[19]

Taking into account the benefits of active engagement in learning, particularly in a collaborative, group-based process, there are good reasons to choose the latter option for the main part. Thus we would suggest giving more weight to this procedure, and to use automatic procedures rather for a comparative part in the course of the work process, in order to critically reflect upon the implications and effects of human versus machine based – or, perhaps more precisely, computer-aided – mapping. As the mapping of contributions to *Critical Making* [at the intersections of] *Design and Digital Humanities*[20] by Jessica Barness and Amy Papelias shows, combinations of computer-based mappings and visualizations can end up being highly suggestive. Yet, at the same time, both the readability and the interpretation of these graphs remain debatable. First, lists of key terms are identified by automated word frequency analyses of single texts. Then, based on a comparative mining analysis, interrelations between these frequencies are established.[21] What do these interrelations tell us? Do they really provide insight into conceptual interrelations, as Barness and Papelias claim?[22] Or do they rather tell us something about vocabulary – about words rather than meanings, intentions, ideas? Keeping in mind the impact of language and metaphor, we should perhaps not completely foreclose some parts of the former are indeed included in the latter – and certainly these results can 'help to better understand the language used to communicate the concept of critical making'.[23] However, it is probably important to mind the gap.[24]

Joseph D. Novak and D. Bob Gowin, *Learning How To Learn,* Cambridge: Cambridge University Press, 2008 (1984).

18 In case we do not have access to some sophisticated A.I.-based software that has been trained both with our method and with our subject matter, chances for an automated qualitative evaluation are probably not so high. However, it should be mentioned that there is already a lot of trainable software around.

19 To quote the eponymous motto Cornelia Sollfrank chose for her *net.art generator*, see http://net.art-generator.com/.

20 Jessica Barness and Amy Papelias (eds) *Critical Making: Design and the Digital Humanities*, *Visible Language* 49:3 (2015), Cincinnati: University of Cincinnati College of Design, Architecture, Art, and Planning, 2015.

21 For a more detailed description of the process and the software used, see Jessica Barness and Amy Papelias, 'Critical Making at the Edges', in Jessica Barness and Amy Papelias (eds) *Critical Making: Design and the Digital Humanities*, p. 9.

22 Ibid. It is not only arguable whether this method is truly 'qualitative' or rather quantitative (at least to a considerable extent), it is also questionable that the connections made this way are 'structural' and, beyond that, show 'communalities' beyond the use of the vocabulary.

23 Jessica Barness and Amy Papelias, 'Critical Making at the Edges', p. 9.

24 A recommendable reading for raising awareness against these kinds of gaps is Johanna Drucker, *Graphesis: Visual Forms of Knowledge Production*, Cambridge, MA: Harvard University Press, 2014.

Either way, just as a map will differ from the territory it aims to cover, gathering these words is only one step of our work-in-progress. Our decision for an alphabetical order may relieve us of the weight of any further elaboration of the semantic network. However, we still have to decide about the choice of key terms to include, as well as the ones to be selected from the list for figuring as examples for our learning cards. Thus, even if we decide to build upon, say, a small reading list of publications clearly dedicated to our subject, Critical Making, what about the mentioned impact of language? How will we deal with seemingly obvious key terms – 'Critical', 'Making', 'Design', and so on – that are given different meanings by different authors? And how will we deal with different terms used by different authors to name issues we would consider as similar or even the same? What about those terms we would consider to be desperately missing? How will we make our choice?

P is for...Prototypes

Why prototyping? If designing and creating our learning tools ourselves can be considered as a valuable part of our learning process, the answer to this question seems already given. But then, at the same time, doesn't learning also mean 'learning from' – learning from others, and not only from those who are actively engaged in our learning community? Indeed, while we want to take care about the quality of our work, we also want to avoid reinventing the wheel. Here, not only will we benefit from research on our subject, but also on our tools. We should also search specifically for prototypes and predecessors in our field – namely, creating learning cards for Critical Making.

Indeed, ours is not the first attempt to bet on this format in the context of Critical Making. In 2015, three years after releasing his substantial collection of zines on our subject matter,[25] Garnet Hertz developed a prototype for *Critical Making Design Process Cards*, 'built as an aid for technology designers to sketch and prototype new designs that are culturally relevant, socially engaged and challenging of current biases in commercial design'.[26]

While this description seems primarily directed to professional design practitioners, one can easily imagine using the cards for educational purposes, e.g. in classes at design schools. Plus, because Critical Making is their subject matter, we would assume that any use of the cards should initiate learning processes – learning by doing. However, at the core is the design process itself, so the intention is indeed, according to Hertz' own definition, 'to actually build' something by following a four-step approach: '1. Identifying core metaphors of a field; 2. Recognizing what the metaphors exclude or marginalize; 3. Inverting the metaphor to bring the marginalized to the center; 4. Building a new alternative that embodies the inversion'.[27]

25 See Garnet Hertz (ed.) *Critical Making*, Hollywood: Telharmonium Press, 2012 (pdf edition 2014), http://conceptlab.com/criticalmaking/.

26 See http://www.conceptlab.com/cards/.

27 See the video of Garnet Hertz' Lecture 'Critical Making: Foundations and Processes of Critically Engaged Design Practice', The School of Media Studies at The New School, New York, 9 February 2015, http://smscommons.newschool.edu/understandingmediastudieslectureseries/2015/02/09/garnet-hertz-critical-making-foundations-and-processes-of-critically-engaged-design-practice/.

The prototyped deck provides a setup of exemplary tasks that are generated by a combination of different card types, splitting up the tasks into conceptual components. However, if we come back to Hertz' definition of this process, we find steps 1-3 already contained within the cards themselves. Of course, this doesn't strictly exclude critical reflection, as such reflection can be stimulated both by the tasks and by the design process itself – not to mention that the use of the cards can be framed by an introduction into Critical Making and a discussion of the results.[28] At the same time, it is clear that by using the cards we acknowledge a particular concept of Critical Making – the one Hertz himself has developed – as a given. Thus, if we want to learn more about the concept, its background and its references in different theories and practices, we should probably rely on other resources as well.[29]

But what could a card deck that integrates the first three steps look like? And what about a card deck with a more open approach, one that allows us to learn about how a broader range of Critical Making processes can be developed and practiced?

In 2017, Karvita Arvind and Tulip Sinha Neel from the Shrishti Institute of Art, Design and Technology set out to develop an adaptation of Hertz' process cards that 'could be used in the Art and Design classroom to teach and learn the concepts of Critical Making'.[30] They started in class with mapping the field, and came up with five main categories to focus on – Technology, Materials, Concepts, Time, and Space – each figuring as the centre of a separate mapping.[31] Two flowcharts were sketched out to further explore possible connections between design processes and processes of Critical Making. The former informed the latter, and both were clearly informed by concepts of Design Thinking.[32] Next, three types of cards were developed. Main cards were related to the main categories identified in the first step, and featured a selection of the terms collected during the mappings. Enabler Cards prompted users with design tasks, such as 'sculpt your idea using clay', 'make a moodboard', and 'use electronics and digital media to build your idea'. Finally, Disruption Cards listed actions like 'donate your best concept' and 'critique another group's most preferred idea'.[33]

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28 As it is done in the framework of Hertz' workshops.

29 Hertz' himself mentions 'critical making (Ratto), critical technical practice (Agre), reflective design (Sengers), near futures (Bleecker), critical design (Dunne & Raby), values in design (Nissenbaum), tactical media (Lovink) and adversarial design (DiSalvo)', http://www.conceptlab.com/cards/. The majority of these references can be traced back to his zine edition from 2012/2014, see Garnet Hertz (ed.) *Critical Making*; many of them also (re-)appear in publications by other authors on the subject; see also the Critical Making Bibliography – Critical Mapping Sources in the appendix.

30 Karvita Arvind, 'Cards for Critical Making', *Medium*, 8 September 2017, https://medium.com/two-penny-arcade/cards-for-critical-making-5a62e82fefb1.

31 Karvita Arvind, 'Cards for Critical Making'.

32 More precisely, the main influence seems to be the concept(s) developed by IDEO that have become immensely popular over the past decade (and are meanwhile featured a. o. by Stanford University and the Hasso Plattner Institute with special educational programs); see Tom Kelley, *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm*, New York: Doubleday, 2001 and Hasso Plattner, Christoph Meinel and Larry Leifer (eds) *Design Thinking: Understand – Improve – Apply*, Berlin, Heidelberg and New York: Springer, 2012. However, it should be mentioned that there are also alternative (and, compared to the former, less business-oriented) approaches to these concepts, see i.e. Nigel Cross, *Design Thinking: Understanding How Designers Think and Work*, Oxford: Berg, 2011.

33 Karvita Arvind, 'Cards for Critical Making'.

Compared with Hertz' cards, this prototype seems to be more open in terms of a broader range of possible concepts of Critical Making in the framework of design processes, and is probably also more clearly directed to collaborative learning processes. At the same time, the rather close link with the popular method of design thinking could be scrutinized. Moreover, the prototype is less clear about the concept of criticality in general, and is also not really outspoken about the concept(s) of Critical Making it builds upon. As mentioned previously, in contrast to both the decks prototyped by Hertz and by Arvind/Neel, the purpose here is not so much to create a set of cards to be used in design processes (whether situated in a classroom or not), but rather to develop a collection of learning cards that provide insight into the various concepts, methods, theories, practices, techniques, and tools associated with Critical Making. With this goal in mind, we need a different approach.

P is for...Proposal

The following paragraphs sketch out a proposal for this process. They are meant as a draft that can be freely adapted, further refined, or even partially or fully rejected. While the procedure should also work for individual projects, a collaborative learning process and an active engagement of the collective of learners in the whole process would probably lead to the best results. So this is not about proposing a strict prototype, but about a more open-ended invitation into a practice. The critical making of the learning cards is a core part of the process.[34]

As a starting point, we propose a mapping of the field based on Critical Making publications with different approaches,[35] in order to identify key terms related to concepts, methods, theories, practices, techniques, and tools. These will serve as our INDEX(ed) terms for our learning cards.[36] Just like traditional index cards, we can add sources to each card, with QUOTES, NOTES on the context, maybe further references or EXAMPLES to supplement this information, and probably also #TAGS that encourage cross-referencing this term with other terms. At this point we might also feel inclined to pin down a brief DEFINITION in our own words and enhance it with #TAGS as well. Now, our index cards are ready – ready to use as flash cards for learning or to use as reference material for other purposes.

But what about the QUESTIONS we've been pondering above? While definitions backed up by references certainly are useful for getting an overview, wouldn't questions be more appropriate to encourage the development of a critical attitude? If so, will the notorious 5W+1H – who, what, when, where, why, and how help? Or do we need to find more complex questions, such as 'in which context?', 'for whom?', 'related to what', or even 'from which

34 And this is indeed an attempt (or, if you like, also a proposal) to point out that Critical Making is, after all, a verb: critical making.

35 As discussed above, both 'manual' and 'automated' procedures might work. However, we'd propose a manual mapping that – when it takes place as a collective endeavor – will also encourage and support debates about the sources and the choice of terms retrieved from these.

36 The main sources for the mapping have been collected in a separate bibliography (Critical Making Bibliography – Critical Mapping Sources) that is based on a more extended research bibliography on the subject. It should be mentioned that the selection was deliberately not limited to texts that explicitly and/or literally discuss 'Critical Making'; the list also comprises texts dealing with related concepts.

standpoint'? Will we finally be able to frame a master question, a question to which our keyword is the answer? Or would we prefer instead to activate a multitude of questions? Some of these questions may prompt us to critically review not only our choice of resources and references, but also our choice of INDEX terms and thus ask for further engagement in the CRITICAL MAKING of our learning cards. Let's give it a try...

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Enkel Collective: Making Change Makers

Benjamin Matthews

ENKEL COLLECTIVE: MAKING CHANGE-MAKERS

BENJAMIN MATTHEWS

> We always said that our mission is to create a new generation of change-makers, not be change-makers ourselves.
>
> - Adam Jorlen[1]

Enkel Collective was established in late 2014 in the small post-industrial port city of Fremantle, near Perth in Western Australia, during the tail-end of a decade long 'mining boom' in a region that relies heavily on primary industries for its economic survival.[2] Not long afterward, my conversations with co-founder Adam Jorlen began, and during an interview in late December 2018, we discussed the journey to date. Here, I reflect on our conversation, sharing portions from a unique sociotechnical experiment that responded to growing precarity by building and sustaining an organized network.

We first met in July 2015, and Adam took me on a tour of a dusty, ancient Navy warehouse by the Fremantle harbor that Enkel had temporary use of. It was cavernous and empty, save for piles of rusting bicycles that were part of a discontinued social enterprise. As we wandered about, he energetically described in his lilting, Swedish accent plans to win permission from local government to keep the huge space. In mid-2019 his patience will pay off and Enkel Naval Store will open.[3]

Enkel plans to deploy 'post-blockchain' Holochain-based cryptocurrency to facilitate a decentralized approach to governance and exchange within the micro-economy of the Naval Store. They hope this system can become a larger experiment in the surrounding community, fostering a transparent, ethically grounded marketplace.[4] As Adam explained, employing emerging technology to facilitate change-making in the long term is a key strategy for Enkel:

> We have been working on the Naval Store for 4 years, and the lease is for twenty years because we are thinking *cross-generational time scales*: that space is for our kids. My hope is that this means my daughter will have a space in which to prototype the future in ten years. This is a living lab, as we always call it, and that's our mission. Many of us have kids, and having that mission keeps us going.

There is a certain patient determination at play here, a drive to move outside the short-cycle tactics that undermine the impact of much activism. To this end, the collective is formally

1 Interview with the author, December 2018. All direct quotes from Adam in this chapter from this source.
2 Estimated to have boosted per capita household disposable income in Australia by 13 percent over the decade to 2013. See Peter M Downes, Kevin Hanslow and Peter Tulip, 'The Effect of the Mining Boom on the Australian Economy', *Reserve Bank of Australia Research Discussion Paper No. 2014-08* (August 22, 2014), https://ssrn.com/abstract=2701080.
3 See Enkel Naval Store, http://www.enkelnavalstore.com.
4 See Holochain, https://holochain.org/.

divided into three arms: Enkel U (a 'School for Change-makers'), the Enkel Naval Store, and Enkel Consultancy.[5] From this base, participants engage in social entrepreneurship, run workshops and events, and work with business, government and non-profits as facilitators and consultants. They conduct social innovation experiments, like establishing temporary makerspaces, MOOC study groups and living labs in a range of settings, including co-working hubs and facilities owned by local government.

This long view, together with the mission to attain a sustainable approach to decentralized forms of organization, has seen Enkel make hard short-term decisions and show a willingness to trial (and fail with) various structures. Following a review in 2017, the collective was pared from 60 people down to 20 core members. This process aimed to create a stable core of trusted individuals, who steward the culture, while an extended, global network of participants numbering in the hundreds provides additional support and resources. Similarly, Adam explained, they enable entrepreneurship, but clip its wings when it falters:

> We had three arms: Enkel Pro, Enkel U, and the Naval Store. Enkel Pro did so well it separated into an entity called Flow Edge, driven by two of our members who are really entrepreneurial go-getters, which didn't work out. I think that was because some people wanted to be full-on consultants working all the time, while others like me wanted to come in and work only sometimes or just as facilitators. So now we're back to Enkel Consultancy. We have regular meetings and we are still trying to sort out how we are going to work together as independent consultants who still have a relation to Enkel.

Market pragmatism filters this mode of post-industrial social entrepreneurship, where decisions about who to work with are always determined by the constant determination to facilitate change-making from the bottom up:

> We work with local and state government enabling creative innovation, highlighting the importance of spaces like makerspaces – we take a bottom up rather than top down approach. We've worked with the Departments of Transport and Water on public consultation workshops for local government around missioning and the future. We focus on a mix between innovation and design thinking and now have 10 consultants on the roster. We also work with the Perth City Farm, a non-profit that needs a new strategy. We work with organizations that have similar values to us. We decided we agree on not going to work with the mining industry or oil and gas.

This values-driven approach is realized in sociotechnical experiments that seek to amplify the potentials in the network by defining the minimal conditions required to permit action. This means decentralizing governance and generating flow as needs dictate – moving back and forth between hierarchy and anarchism, loose bonds and tight, consensus and disarray, inclusion and exclusion. To put it in Adam's words, to achieve these goals, 'we have to create an organization that is an effective container, that can hold those paradoxes'.

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5 Enkel Collective, https://www.enkel.co/.

Experiments in decentralized decision-making are the best example, particularly the use of the open-source cloud-based software Loomio. Loomio provides every participant with an equal opportunity to contribute, support, vote on, or block decisions from a smartphone application, securely recording this process for later review.[6] After a slow beginning, Adam explains, Loomio has proven increasingly effective at facilitating transparent, inclusive, and egalitarian decision-making processes:

> Loomio is really good but it has taken a long time in the same way as other stuff. In the beginning people didn't use it. Now people use it all the time and start to understand, 'AHA! This is nothing I can just decide, this is something that is going to affect more people, I better put it on Loomio'. The person who was here running Enkel U has just moved to Melbourne, and she wants to set up something similar there under our auspices, and she will have to go through that process on Loomio. We are co-hosting a New Economy Network Australia (NENA) conference next month here in Perth, and they will have to put that up on Loomio to ask the group if they are OK to take that risk – which it is, to organize a big conference.[7] People only have to put up the big stuff, and they have to learn the difference. The interesting thing about Loomio is that people care about the possibility to have their say, not about having their say. Normally they don't vote, and the main vote is 'abstain', which means I trust you; I trust the group. But they get pissed off if decisions get made without being put up on Loomio. *It's almost like an automatic liquid democracy*, and if you're passionate about something you will jump in. In general persistence is the main thing.

It is inclusive transparency that mediates consensus through this rather simple technical solution. While the technology is a capable facilitator, its affordances are entangled with the cultural practices of the network and persistence has been the marker of its success, particularly in ensuring consensus is maintained. As Adam observes, they have discovered that decentralizing governance allows consensus to facilitate highly independent endeavors:

> For example, one participant wanted to start a co-working space and he just went off and did it and made it happen independently, and the one thing he put on Loomio was the question: Can I say this was supported by Enkel on the website? And the group said: 'Yes'. That's the one rule we have: it has to be supported by the group.

The quality of gradual adoption, and the importance of transparency and trust, are persistent themes in this cooperative structure. As a technical culture emerged within Enkel over time, collective activity that operates on a decentralized basis became more feasible. That is, the effective use of decision-making software did not require technical literacy so much as a culture of recognition for its effectiveness and relevance. On top of this,

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6 See Loomio, https://www.loomio.org/. For an extended discussion of Loomio, see Benjamin Matthews, 'Precarity, Globalism and Resistance in Emergent Collectivism: The Case of Enspiral', *Global Media Journal* 10.2 (2016).

7 See New Economy Network Australia, https://www.neweconomy.org.au.

the participants demonstrate their cultural knowledge by understanding the difference between decisions that require collective participation, and those that do not.

This engagement with software is in part due to a general orientation toward transformation that is led by technology – particularly where a scalable, radical alteration might be prototyped to disrupt and reconfigure current paradigms of exchange in economic, cultural, and political settings. For example, Adam explains their interest in blockchain as follows:

> We did a lot of work with the 'post-blockchain' tech Holochain this year, and we want to go seriously into not only collaborating with government, but we want to start our own local economy within the Naval Store with a coin you can use to buy things in there, and see if that can move out to more people, like cafes, restaurants and business in Freeo [Freemantle]. Holochain is more aligned with our values than older blockchain-based cryptocurrencies. You can't use it to speculate and it's based on a system called 'mutual credit' and it's way more interesting for us.[8]

The network culture that Enkel participants are entangled with is characterized by a specific ethos where knowledge acquisition is both aspirational and values driven. It is not enough to take up bleeding-edge technology like blockchain, for instance, merely for the sake of its newness. Instead, it is the capacity for change-making toward particular goals that determines its use.

Again, sustainability, resilience, and long-term impact mark the way the collective engages with technology and is shaped by it. But this pattern is inspired by network interactions, and the general orientation toward tapping the potentials in agency created by fluid interactions and open structures. As Adam noted, the original move towards blockchain technologies was directly inspired by this ethos:

> We had one member who was a really good Ethereum developer, so we were pulled into his world. He was the CTO [Chief Technology Officer] for an early blockchain ICO [Initial Coin Offering] called Powerledger, and we were hanging out with them. We are really curious people at Enkel, so we go into everything.[9] We are all over the place, some of us are going to things to do with IoT [Internet of Things], others blockchain, some theory U, then we share that and cross post and go to each other's events. It's a really interesting thing, how it works.

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8 A mutual credit system can be most simply understood as an 'IOU' network. Units of currency are issued when a participant extends credit to another user in a standard spending transaction; peers in the network agree to the later exchange of this credit for any good or service, and their balance should return to zero before leaving the system. See the P2P Foundation Wiki entry for a range of resources on the topic: https://wiki.p2pfoundation.net/Mutual_Credit.

9 ICO stands for Initial Coin Offering, which is the capital raising equivalent in blockchain start-ups of an IPO for public companies, where the contributor is typically rewarded with a novel cryptocurrency.

Dialogue is the generative force that drives this process, both within the collective, and with the world, and sudden change is often based on this conversation. The members critically engage and experiment with both traditional and avant-garde ways to hack existing organizational structures and practices for their own purposes in a range of public and internal fora.

For example, Adam explained that Enkel members connected with participants in NENA based in Brisbane, Queensland, on the far side of Australia. This originated a further process of discovery and relationship building that uncovered a local network of people already attempting to prototype new modes of exchange:

> I know a lot of people in this scene, like you, across the world. I am always scanning. Four Enkel people went to meet the NENA people in Brisbane and go to their conference to see what is going on in 2017, and we really liked it. So we thought: why don't we do one here in Perth? The cool thing with bringing together all these new economy-related things – like permaculture, cooperatives, blockchain, renegade education, so many different things – is it all fits in, like makerspaces, tool libraries, and we are like 'cool, this is all the stuff we have been doing for the past few years'. A person who is not a systems thinker, trying to see how these things are related, might think *it's just a fucking mess!* What is this conference about? [laughs] You know? But for us, this is just exactly what we are about. So, we held one here in August [2018], we had 140 people there or more, and we were like, *HOLY SHIT! Who are all these people?* But you see there are people like us, hiding in various rooms and corners of every city, but there haven't been many forums to bring them out and Enkel is one of those forums and this conference is a good example and we will do another one next year in October. *The 20 people in Enkel have a big reach,* we had blockchain, permaculture, game designers using games for good, cooperatives (the new kind, not the old like farmers etc.), Theory U, steady state economics, currency designers, new possibilities for Western Australia.

The dynamics of the collective are reflected in fora like this, where the network is suddenly scaled into a larger, more diverse group of mutually supporting change-makers. This is how Adam has frequently characterized Enkel: as a power base that amplifies patterns of resistance.

Within this cultural scene, the role of scalability is central, and in important ways located in the sociality of network interactions. If scaling up is to be achieved, it is not at the expense of the ideal of decentralized governance. After all, scaling always holds the danger of collapsing into older social paradigms of hierarchy and control. If scaling holds a certain ambivalence, this is partly because it is the sociality of the org-net that defines trust. For Adam, trust emerges from the rhythm of direct relations, and it is these interpersonal interactions that creates the continuity he considers vital to their resilience:

> Sometimes you have to centralize, so we have our regular weekend retreats with the whole group. *That's the most important thing in the collective,* and it's where we don't talk that much about Enkel; it's about building relationships with each other. Then

> we go out and do our own thing. We have four co-op meetings a year, which are an update on projects, two retreats a year, and we meet up every Thursday night, which can be anything. A dinner, a workshop, a presentation. Tomorrow we are doing a skills inventory workshop where we help each other get our skills out, sometimes we go to another organization's event as a more social thing. *You gotta have a rhythm.* Even if we don't wanna meet or don't have anything to talk about, we have to keep the rhythm of meeting. It's one of the key things.

So it is interpersonal relationships, not more formal network interactions, that forge the basis of trust. However, consistent dialogue with a larger network of interactants remains important in that these interactions can be parlayed into activism. The dynamics of this activism are charged by potentials that the members are aware of and seek, but can sometimes be surprised by. In the end, the resilient quality of the collective defines its capacity to resist the larger forces that surround it, where the balance between action and destruction is always poised to shift. Enkel use technology to manage these dynamics, but where they succeed it is due to persistence and critical engagement, not the sudden appearance of a *deus ex machina.* The decision-making software Loomio, for instance, was not an initial success, and their interest in Holochain is driven by the goal of a transparent model of exchange in the long term, rather than bloody minded entrepreneurship or speculation.

And here we arrive at the paradox of Enkel: a collective that fosters change-makers by allowing contradictory patterns to co-exist with unchanging continuity. Meaningful change requires uniting disruption and stability. A sustainable organization of this kind has proven to be generative of resilience in the face of growing precarity, and as relationships mature, so too does the network culture. But Adam deserves the final word, and he explains it like this:

> We all talk about entrepreneurship, and that can be cutthroat like Silicon Valley – it's not like that here. But creativity is always destruction, if someone starts something new it fragments the group and creates tensions. But now, people have been here so long, that they tend not to leave even if they're pissed off. Now people are annoyed for a while, and then they come back. It's like a family, I suppose. It's a very diverse weird collective that would never hang out if it wasn't for Enkel – some of us are friends of course. Its Muslims, hardcore Christians, you know, but it works.

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C-Node: Subverting the Black Boxes of Amazon Web Services in Dublin

Paul O'Neill

C-NODE: SUBVERTING THE BLACK BOXES OF AMAZON WEB SERVICES IN DUBLIN

PAUL O' NEILL

Black Box City

Over the past 20 years, Dublin, the capital city of the Republic of Ireland, has become an important node within the physical and corporate infrastructure of the internet. This is a result of some of the most dominant tech companies of our current networked era, such as Amazon, Google and Facebook, maintaining significant operations there. These operations take place in the various corporate headquarters located in the city center, and also within the massive hyperscale data centers situated in various business parks and industrial estates in its suburbs. The size and scale of these companies are so vast and complex that they are almost impenetrable, reminding us of the 'black boxes' of technology as suggested by Bruno Latour – we know what goes into them and what comes out, but their internal processes are a mystery to most.[1]

This article discusses an ongoing practice-based research project by the author that investigates the operations of these companies, with a particular focus on Amazon Web Services. It argues that the black box metaphor can be applied to Dublin itself, due to the various complexly overlapping digital, political, social, financial, and physical infrastructures surrounding the tech companies based there. From identifying physical infrastructures of the internet within Dublin to the analysis of Internet Protocol (IP) addresses alongside planning permission documents, this article documents creative strategies that engage with this black boxing of technology.

Making and Breaking

Critical making is an approach that links two different types of practice that normally exist within two separate fields, critical thinking and physical making.[2] It is a reaction to the 'maker' movement perhaps best exemplified by *Make Magazine*, or as Garnet Hertz puts it, 'after learning a 3D printer, making an LED blink, or using an Arduino, then what?'.[3] Critical making is also linked to a media archaeology approach as suggested by Garnet Hertz and Jussi Parikka. This approach incorporates practices and exercises surrounding DIY culture that are 'closely related to the political economy of Information Technology'[4] and which are used as artistic methods and tools

1 Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society*, Cambridge: Harvard University Press, 1987.

2 Matt Ratto, 'Critical Making: Conceptual and Material Studies in Technology and Social Life', *The Information Society* 27 (2011): p. 253.

3 Garnet Hertz (ed.) *Critical Making*, Hollywood, CA: Telharmonium Press, 2012, http://www.conceptlab.com/criticalmaking/.

4 Garnet Hertz and Jussi Parikka, 'Zombie Media: Circuit Bending Media Archaeology into an Art Method', *Leonardo* 45.5 (2012): p. 425.

for both investigation and intervention.[5] This approach allows us look inside the black boxes of technology to not only analyze the physical materials within, but also to consider and reflect on the underlying systems and infrastructures from which they emerge. As 'things' become more and more 'connected', it is increasingly important to look beyond and beneath the object itself, to consider where, how, and why this connectivity is occurring and also the consequences of it. Both critical making and media archaeology provide a conceptual space in which to do so.

There are many artists currently excavating the black boxes of the technological artifacts and interfaces of our networked society, informed in part by the approaches mentioned above. These include Benjamin Grosser,[6] the Critical Engineering Group,[7] Joana Moll,[8] Share Lab,[9] VTOL,[10] and many others. Other examples that engage similarly with technology from these conceptual viewpoints can be found in accompanying texts and manifestos from this community. The *Critical Interface Manifesto* speaks of the interface as 'the tip of the iceberg of a complex system of agents/agencies, of interdependent infrastructures, codes, data, applications, laws, corporations, individuals, sounds, spaces, behaviors, objects, protocols, buttons, times, affects, effects, defects'.[11] Similarly, the *Critical Engineering Manifesto* argues that our dependency on any given technology requires 'the need to study and expose its inner workings' and 'considers the exploit to be the most desirable form of exposure'.[12]

The work of artists such as those mentioned above, alongside manifestos that simultaneously highlight the need for a critical engagement with technology whilst suggesting conceptual lenses in which to do so, allows us to understand and engage with complex techno-political issues from a creative perspective. Whilst there are limitations in these approaches, they are offset by the scope for experimentation within the investigative process and more importantly, for the potential dissemination of the research undertaken within these artistic practices. These practices are able to circumnavigate 'official' narratives of technological progress. In so doing, they shed light on the corporate, political, and physical infrastructures that technological systems and devices are built upon.

Celtic Tiger, Californian Ideology

In recent years Ireland has become a significant global hub in relation to the strategic business interests of the information & communication technology (ICT) companies based there.[13] Despite its location on the edge of Europe, it is very much at its center in relation to the presence of ICTs. The industry employs over 37,000 people and generates exports worth €35

5 Hertz and Parikka, 'Zombie Media', p. 425.
6 Ben Grosser, https://bengrosser.com/.
7 The Critical Engineering Working Group, https://criticalengineering.org/.
8 Joana Moll, http://www.janavirgin.com/.
9 The Share Lab, https://labs.rs/en/.
10 VTOL, http://vtol.cc/.
11 Hangar, 'Manifesto for a Critical Approach to the Interface', 2015, https://interfacemanifesto.hangar.org/index.php/Main_Page.
12 Critical Engineering Group, 'The Critical Engineering Manifesto', 2011-2019, www.criticalengineering.org .
13 IDA Ireland, https://www.idaireland.com/doing-business-here/industry-sectors/ict.

billion annually.[14] This is a result of Ireland's long history of attracting Foreign Direct Investment (FDI), which started in the 1950s.[15] International tech companies have been based in Ireland since this period. IBM, for example, established an office in 1956.[16] The active cultivation of FDI by successive Irish governments saw many international tech companies establishing assembly operations from the 1980s onwards, including Apple, Ericsson, and Fujitsu, who were later followed by Intel, Microsoft, Xerox, and Cisco.[17] This growth continued into the new millennium, and today many of the tech companies associated with the Web 2.0 era have significant operations in Ireland, including Amazon, Facebook, Google, and Twitter. Most of these companies operate out of the Grand Canal Dock area of Dublin City, now commonly referred to as 'Silicon Docks'. To the more cynical, or indeed critical, the Silicon Docks narrative can be viewed as the Celtic Tiger developing its own 'Californian Ideology'.[18] The reasons these tech companies choose Ireland as their corporate base are varied and include a generous corporate tax rate, political stability, proximity in relation to the US, UK, and EU, the presence of an English-speaking and well-educated workforce, along with relaxed conditions for attracting non-national specialized workers.[19] All of these factors have made Ireland a significant node within the international corporate tech infrastructure.

Whois Ireland

Influenced by the work of Share Lab, in particular their investigations surrounding the tracing of internet protocol (IP) addresses,[20] I began to look to look at IP addresses in Ireland. Specifically, I had two guiding questions, how many IP addresses are registered in Ireland and who are they registered to?

Whilst there are networking tools such as *traceroute* and *whois* that provide information about IP addresses, they were unfeasible due to the amount of IP addresses I was attempting to identify. Consequently, I used various online IP geolocation resources.[21]

As of July 2018, Ireland had 12,274,155 IPv4 addresses assigned to it, 82% of which were controlled by 10 different corporate and state entities.

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14 IDA Ireland, https://www.idaireland.com/doing-business-here/industry-sectors/ict.

15 Stephen Smith, 'FDI – Ireland's 50 Year Overnight Success Story', *Irish Central*, 16 May 2014, https://www.irishcentral.com/business/technology/fdi-irelands-50-year-overnight-success-story.

16 'IBM in Ireland: 5 Decades of Innovation', *IBM,* 2006, https://www-05.ibm.com/ie/ibm/pdf/50yearsInnovation.pdf

17 Paul Donnelly, 'How Foreign Firms Transformed Ireland's Domestic Economy', *The Irish Times*, 13 November 2013, http://www.irishtimes.com/business/how-foreign-firms-transformed-ireland-sdomestic-economy-1.1593462

18 Richard Barbrook and Andy Cameron, *The Internet Revolution: From Dot-com Capitalism to Cybernetic Communism*, Amsterdam: The Institute of Network Cultures, 2015.

19 IDA Ireland, https://www.idaireland.com/doing-business-here/industry-sectors/ict.

20 'Invisible Infrastructures: Internet Map of Serbia', *Share Lab*, 7 February 2015, https://labs.rs/en/internet-map/

21 Infobyip.com and ip2location.com.

Company	# IP Addresses Registered
Amazon.com Inc.	8,833,910
Heanet Ltd.	1,842,432
Eircom Ltd.	1,087,213
Microsoft Corporation	1,028,199
Liberty Global Operations B.V.	517,826
BT Communications Ireland Ltd.	507,246
Imagine Communications Group Ltd.	484,296
Vodafone Ireland Ltd.	427,008
Apple Inc.	213,265
Three Ireland (Hutchison) Ltd.	168,936
Total	*10,110,331*

Fig. 1. Paul O' Neill, Top ten companies with IPv4 addresses registered in Rep. of Ireland, 2018.

As the above table shows, the top ten mostly consists of internet service providers such as Vodafone, BT, and Three. We also see Heanet Limited, which is Ireland's National Education and Research Network.[22] However, what is most interesting in this table is the presence of the tech companies mentioned earlier, Apple, Microsoft, and in particular, with almost 33% of all IPv4 addresses in Ireland registered to it – Amazon. At this point, it should be noted that the online resources used for this exercise are not verifiable. Also, public IPv4 addresses do not tell the full story in relation to network engineering infrastructures. However, the above exercise provided enough information for me to begin to look at the operations of Amazon in Ireland.

(Un)Availability Zone

Amazon established operations in Ireland in 2004 and currently employs 2,500 people, 1,500 who are employed by its subsidiary cloud computing company *Amazon Web Services* (AWS).[23] Alongside its Burlington Road corporate offices, located in an affluent part of Dublin a few minutes walk from the Silicon Docks, Amazon also operates a number of data centers in Dublin. The data center industry is growing rapidly in Ireland and is expected to have invested €9 billion in the economy by 2021.[24] There are 48 operational data centers in Ireland as of November 2018.[25] The majority of these are

22 Ireland's National Education and Research Network, heanet.ie.

23 Aengus Cos, 'Amazon to Create 1,000 Dublin Jobs Over Next Two Years', *RTÉ,* 19 June 2018, https://www.rte.ie/news/2018/0618/971353-amazon-web-services-jobs/

24 Ciara O' Brien, 'Data Centre Investment in Ireland to Near €9bn by 2021', *The Irish Times*, 10 April 2018, https://www.irishtimes.com/business/technology/data-centre-investment-in-ireland-to-near-9bn-by-2021-1.3456781.

25 David McAuley and Garry Connolly, 'Ireland's Data Hosting Industry, 2018, Q3 Update', Host in Ireland & Bitpower Energy Solutions, November 2018, http://www.bitpower.ie/images/Reports/Bitpower_2018_Q3_Update_V1sml.pdf.

located in business parks and industrial estates surrounding Dublin city. These are all in close proximity to the T50 fibre optic cable that follows the M50 motorway around the city. Most of the data centers in Ireland are 'hyperscale' facilities operated by Facebook, Google, Microsoft, and AWS.

The international infrastructure of AWS data centers is based around *Regions* and *Availability Zones* (AZs). A region is a geographical division composed of availability zones, which are essentially clusters of individual data centers. As of March 2019, the global infrastructure of AWS spans 20 different regions, comprised of 61 availability zones.[26] Ireland is one such region, 'EU-West-1', and has three different availability zones, all located around Dublin city and in close proximity to the T50 fibre optic cable mentioned previously. As artist Ingrid Burrington notes, unlike other hyperscale operators, AWS prefers to keep the locations of its data centers as quiet as possible.[27] So much so in fact, that in October 2018 WikiLeaks published what it referred to as a 'highly confidential' internal AWS document, listing the locations of over 100 AWS data centers worldwide.[28] Within the context of my own research I did not have to rely on leaked documents. Although it is difficult to find the exact locations, in comparison to other hyperscale operators, of AWS data centers in Ireland, I was able to accurately pinpoint their locations by accessing publicly available planning permission documents on the website of South Dublin County Council.[29] Figure 2 below shows the planning permission site map for an AWS data center. Figure 3 shows a Google map aerial view of the same site.

You will notice in Figure 3 how the AWS data center is not listed. Of course, this is logical because in order for AWS to be listed here, they would have to list themselves. Also, if you go into Google street view you can see the data center in question. However, I would still suggest that this raises questions about the absence of representation of these massive physical infrastructures within virtual cartographies.

Having identified the locations of the data centers, it was now time to 'visit' one of the Availability Zones in Tallaght, a working class suburb in west Dublin. This particular Availability Zone comprises 3 different data centers, with two more currently under construction. The building themselves are mostly windowless, surrounded by fences with signs warning that the sites are monitored by international security company G4S. There is no indication of what the buildings are used for or who owns them, with the exception of planning application notices, which they are legally obliged to display. It is hard to stand outside of these buildings and not be reminded of the black boxes of technology mentioned earlier.

26 AWS Amazon Global Infrastructure, https://aws.amazon.com/about-aws/global-infrastructure/.

27 Ingrid Burrington, 'Why Amazon's Data Centres are Hidden in Spy Country', *The Atlantic*, 8 January 2016, https://www.theatlantic.com/technology/archive/2016/01/amazon-web-services-data-center/423147/.

28 Amazon Atlas, *WikiLeaks,* 11 October 2018, https://wikileaks.org/amazon-atlas/.

29 South Dublin County Council: Planning Applications, http://www.sdublincoco.ie/Planning/Applications?p=1&name=ADSIL.

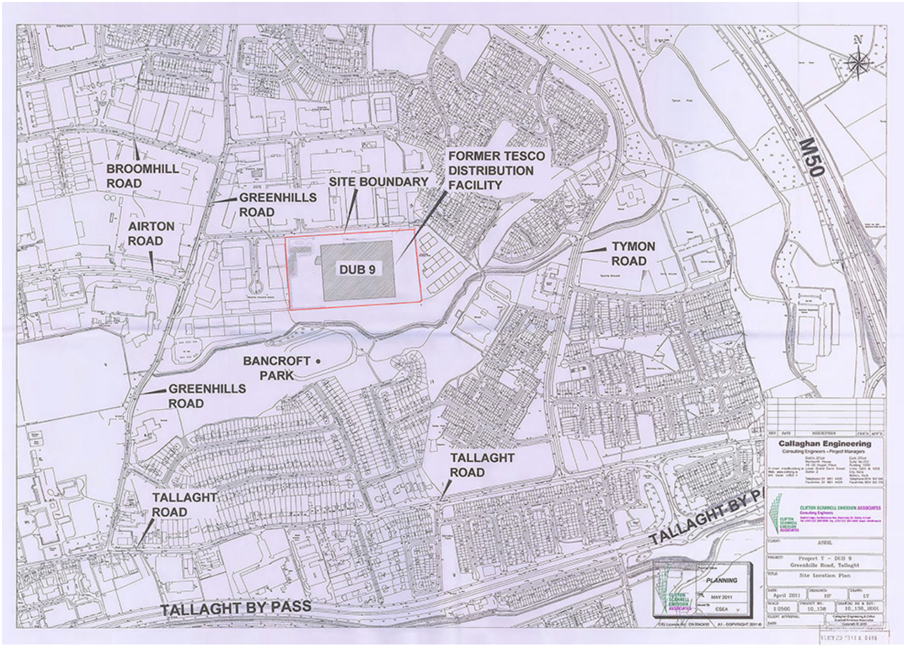


Fig. 2. Callaghan Engineering, AWS planning application map, 2011.[30]



Fig. 3. Paul O' Neill, Screenshot of Google maps aerial view of AWS Data Centre on Greenhills Road, Tallaght, Dublin 24, 2018.

30 'SD11A F0116', South Dublin County Council: Planning Applications, 5 November 2011, http://www.sdublincoco.ie/Planning/Details?p=1&name=ADSIL&regref=SD11A%2F0116, For educational use only, no copyright infringement intended.



Fig. 4. Paul O' Neill, Side view of AWS data center on Greenhills Road, Tallaght, Dublin 24, 2018

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Fig. 5. Paul O' Neill, front view of AWS data center on Greenhills Road (note planning permission application on fence), Tallaght, Dublin 24, 2018.

This is all in stark contrast to the AWS corporate offices mentioned earlier, where workers stream out of the office wearing polo shirts and lanyards with the AWS logo emblazoned upon them. I have visited this Availability Zone on several occasions. On some of these outings I have been approached by security guards telling me that I was not permitted to take pictures of the building, even though I was standing on a public road. On these occasions I have asked the security guards the following two questions: what are inside the buildings, and who owns them?

Each time the security guards have declined to answer either question, usually responding with a variation of 'we are not allowed to say'. If it wasn't so ridiculous (the planning permission applications (Fig.5) have Amazon or ASDIL (Amazon Date Services Ireland Limited) printed on them), it would be sinister. So, aside from obvious concerns surrounding public access and photography, and more general concerns in relation to data centers such as data sovereignty, environmental impacts, and so on, why should we focus on AWS and their operations in Ireland?

Apart from customers such as AirBnB, Ryanair, and Netflix, AWS also works with the American Government. It operates a region called 'Govcloud' which is used by various US governmental agencies to host sensitive data.[31] In 2017, it announced an 'AWS Secret region', which works specifically with US intelligence services to store and access information across all classification levels up to and including 'top secret'.[32] AWS has also been criticized for selling its facial recognition software '*Rekognition*' to different law enforcement agencies.[33] At the time of writing, AWS is also believed to be in the running for a $10 billion contract for the US department of Defense's Joint Enterprise Defense Infrastructure (JEDI) project, which will see the Pentagon moving completely into the 'cloud'.[34] Whilst this contract is not confirmed, putting it together with AWS's other engagements with the US military and government begins to resemble what Brian Holmes refers to as the 'imperial infrastructures' of ICTs.[35] Whilst all of these issues are not necessarily occurring on Irish soil, we really have no way of knowing for sure. Regardless of this, AWS's significant, yet almost invisible, presence in Ireland is enough to raise questions or some form of critical engagement beyond the aforementioned Silicon Docks narrative.

So what to do with all this information? How best to disseminate it to an audience beyond the academy? Tech companies such as AWS all interact with each other, with the government, with the local infrastructureyet these interactions are to a certain extent black boxed. We are aware that they are there and what they do externally, but we never really get to see how everything is connected, the corporate to the physical, the physical to the political, and so on. Matt Ratto

31 'Introduction to the AWS GovCloud Region', *AWS Amazon,* https://aws.amazon.com/govcloud-us/.

32 'Announcing the new AWS Secret Region', *AWS Amazon,* https://aws.amazon.com/blogs/publicsector/announcing-the-new-aws-secret-region/.

33 'Coalition Letter to Amazon Urging Company Commit not to Release Face Surveillance Product', *American Civil Liberties Union*, 15 January 2019, https://www.aclu.org/coalition-letter-amazon-urging-company-commit-not-release-face-surveillance-product.

34 Naomi Nix, 'Inside the Nasty Battle to Stop Amazon From Winning the Pentagon's Cloud Contract', *Bloomberg,* 20 December 2018, https://www.bloomberg.com/news/features/2018-12-20/tech-giants-fight-over-10-billion-pentagon-cloud-contract.

35 Brian Holmes, *Unleashing the Collective Phantoms: Essays in Reverse Imagineering*, Brooklyn: Autonomedia, p. 32.

notes that by understanding the systems and artifacts that we build, we can 'contrast them both (materially and semiotically) in more liberatory and productive ways', developing methodologies that create a better understanding of our material engagement with technology is of the utmost importance.[36] This understanding needs to extend beyond technological artifacts themselves and to the systems and infrastructures they are integrated within, be they corporate and digital, such as GDPR, economic, such as corporate tax rates, the double Irish etc, or the actual physical infrastructures, the 'stuff you can kick'.[37] In short, greater transparency is needed, and if it is not coming from those controlling these systems, we should provide it for ourselves and for each other. As for AWS and their desire for invisibility in relation to their cloud based operations, we can look to the work of Andrew Blum, who argues that 'if we're entrusting so much of who we are to large companies, they should entrust us with a sense of where they're keeping it all, and what it looks like'.[38]

C-Node: a Tour of Dublin's Internet and Corporate Tech Infrastructures

The idea of exploring the mediated city as a participatory experience has been used by many artists, including Benjamin Gaulon (*2.4Ghz Workshops,* 2008–present),[39] Conor McGarrigle (*NamaLand*, 2010),[40] Nick Briz and Brannon Dorsey (*Wifi Data Safari Workshop,* 2018),[41] RYBN (*Offshore Tour Operator,* 2018),[42] and Mario Santamaria (*Madrid, Barcelona and Zaragoza Internet tours*, 2018–2019),[43] amongst others. Diverging from a media archaeology that focuses on 'media', Shannon Mattern advocates an 'urban media archaeology' that investigates how media networks are dependent on other infrastructural networks.[44] Because of the concentration of large tech companies based here and their proximity to key elements of the internet's physical infrastructure, Dublin provides an excellent case study for this approach. Mattern also suggests that participation in projects like walking tours 'create their own further infrastructures – informational, social, political, creative etc – for further action'.[45]

In October 2018, I invited a number of artists, academics, and activists to join me on a guided walking tour entitled 'C-Node: A Tour of Dublin's Internet and Corporate Tech Infrastructures'. Since then, I have led various iterations of the tour with both individuals and groups. The purpose of this tour is to explore elements of Dublin's physical internet infrastructure alongside the corporate topologies that support it, and in doing so, to raise awareness of Ireland's relationship with the tech companies based there.

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36 Megan Boler and Matt Ratto (eds) *DIY Citizenship: Critical Making and Social Media*, Cambridge, MA: MIT Press, 2014, p. 222.

37 Lisa Parks, '"Stuff You Can Kick": Toward a Theory of Media Infrastructures', *Academia*, https://www.academia.edu/16426095/Stuff_You_Can_Kick_Toward_a_Theory_of_Media_Infrastructures.

38 Andrew Blum, *Tubes: Behind the Scenes at the Internet*, London: Penguin Books, 2012, p. 240.

39 Benjamin Gaulon, http://www.recyclism.com/twopointfourwksp.php.

40 Conor McGarrigle, https://www.conormcgarrigle.com/namaland.html.

41 Nick Briz and Brannon Dorsey, https://brangerbriz.com/blog/exploring-our-surrounding-wifi-landscape.

42 RYBN, http://rybn.org/thegreatoffshore/index.php?ln=en&r=3.OFFSHORE_TOUR_OPERATOR.

43 Mario Santamaria, https://internetour.com/.

44 Shannon Mattern, *Deep Mapping the City*, Minneapolis, University of Minnesota Press, 2015: pp. xi-xii.

45 Shannon Mattern, 'Infrastructural Tourism', *Places Journal,* July 2013, https://placesjournal.org/article/infrastructural-tourism/.

The tour begins with a short presentation of my general research and methodologies into Dublin's internet infrastructure, alongside the conceptual lenses that have informed it, including critical making and media archaeology. This is then followed by a guided walk through Dublin city centre, where we trace physical aspects of the internet within the city via cellular towers and underground fibre optic cables (Fig.6), using Ingrid Burrington's *Networks of New York: An Illustrated Field Guide to Urban Internet Infrastructure* as a guide. The next part of the tour takes place in the Silicon Docks areas of the city. Specifically, we 'visit' the offices of AirBnB, Facebook, and Google, where myself and various guest speakers give a series of small presentations on the issues and concerns associated with these companies (Fig.7). The final part of the tour visits the AWS Availability Zone in Tallaght discussed earlier (Fig.8). The tour then concludes with a conversation between all the participants on the findings of the tour and possible future steps and actions.

Artist Jonah Brucker-Cohen suggests that 'network interaction can be subverted by creating projects that emphasize the surrounding factors of networked interactions such as the location, physical proximity, connected data streams, and mindset of users'.[46] This is the intention of C-Node, to subvert the network interactions of the corporate tech entities based in Dublin by linking their operations within the city to the rest of the networked world. Through this process, it is hoped to facilitate public conversation and debate within the local context surrounding the 'external façades'[47] of ICTs and the black boxes upon which they are built.[48]



Fig. 6. Participants of a C-Node tour tracking fibre optic cables in Dublin City Centre, 2019, photo by Harikrishnan Sasikumar.[49]

46 Jonah Brucker-Cohen, 'A Design Methodology for Deconstructing Networks', in Garnet Hertz (ed.) *Critical Making: Manifestos*, Hollywood: Telharmonium Press, 2012, pp. 33-38. http://conceptlab.com/criticalmaking/PDFs/CriticalMaking2012Hertz-Manifestos-pp33to38-BruckerCohen-ADesignMethodologyForDeconstructingNetworks.pdf.

47 Friedrich Kittler, *Optical Media*, Cambridge: Polity Press, 2010, p. 32.

48 Garnet Hertz and Jussi Parikka, 'Zombie Media', p. 428.

49 Reprinted with permission of the creator.



Fig. 7. Participants of a C-Node tour outside of Facebook's EMEA HQ in Dublin 02, 2019, photo by Harikrishnan Sasikumar.[50]

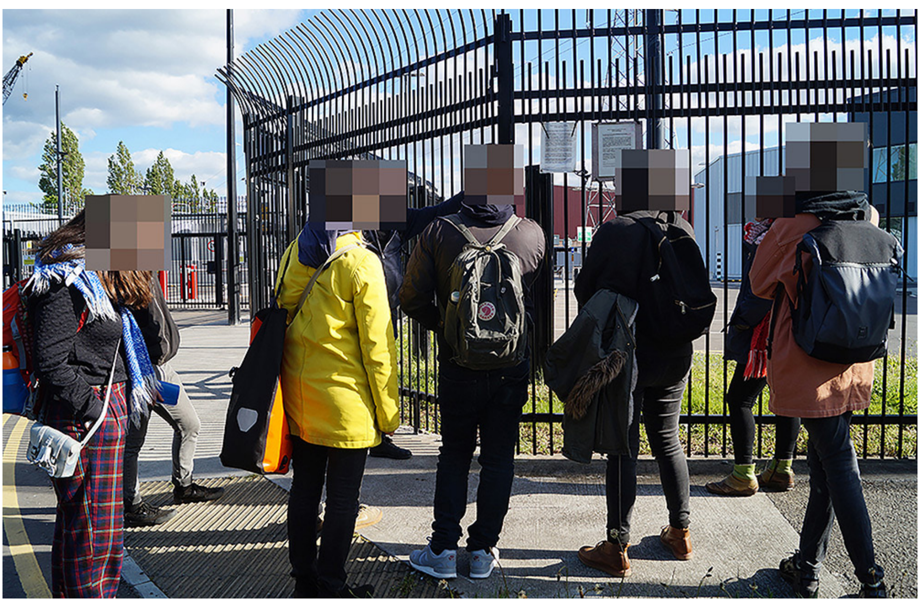


Fig. 8. Participants of a C-Node tour outside of an AWS data centre in Tallaght, West Dublin, 2019, photo by Èrika Marcet.[51]

50 Reprinted with permission of the creator.
51 Reprinted with permission of the creator.

Participatory Explorations

This research is still in progress. It is a project that seeks to reflect on and engage with many of the key issues of our current networked society. As these issues further expand and permeate our lives, projects and interventions such as C-Node need to continually adapt and evolve to react to them. In relation to AWS and the many other tech companies of the digital era, their influence and dominance is not just through the digital interfaces we interact with, but also in the physical, real world. The physical infrastructure of ICTs spans borders, markets, states, and ideologies. This means that, although C-Node is a project rooted in Dublin, the issues it highlights and the creative dissemination of research it suggests are relevant and applicable anywhere. Artistic interventions and technological provocations not only raise awareness of these issues, but also promote an engagement with technology that is more critical and reflective than conventional discourses. It is important to disseminate practice-based research beyond the academy or gallery in order to share information with others who may not normally have access to such information. In turn, the conversations generated by disseminating such research outside of 'traditional' areas can lead to more engagement, more discourse, and perhaps galvanize other interventions. C:Node seeks to promote participatory engagement so that others can explore the corporate topologies of the internet that surround us, collectively and critically.

Acknowledgements

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Demolition Machines: Making and Thinking with Databases of Urban Regeneration

Tom Keene

DEMOLITION MACHINES: MAKING AND THINKING WITH DATABASES OF URBAN REGENERATION

TOM KEENE

Cressingham Gardens Estate (henceforth Cressingham) is a green and leafy social housing estate based in South West London that is owned by Lambeth Council (henceforth Lambeth). The estate has a low crime rate and is well liked by the majority of residents. I purchased my leasehold home on Cressingham in 2006 and currently live there with my wife and two young children. In 2015, Lambeth cabinet members voted to demolish Cressingham as part of their (now) £1.6 billion borough-wide program of urban regeneration.[1]

In 2012, Lambeth housing officers (henceforth officers) began consultation meetings with residents and commented that 'the database told us Cressingham is too expensive to repair'. This comment inspired my PhD research project *Database (e)State* that investigates the role of Lambeth's housing databases in the maintenance, repair, and regeneration of their housing stock. This ongoing project and thesis provides the basis of this essay.[2]

I undertake acts of making, programming, activism, and theoretical and technical research in order to address the complexities of urban regeneration. These acts combine into strategies that highlight and influence the ways that Lambeth produces knowledge of Cressingham and then acts on its buildings and residents. I created one strategy, the *Service Charge Parser*, to support resident efforts to contest over £127,000 of historic repairs on Cressingham. However, before I discuss the Parser, it is important to provide some context and introduce Lambeth's databases as more than a technological concern.

In 2012, officers cited widespread structural issues across Cressingham's 306 homes – which can be roughly divided into 210 council tenants, 90 homeowners, and 6 properties that have been left empty or in a state of disrepair since 1999. Officers, however, provided no evidence of major structural problems, so residents pushed for a survey of *all* buildings. However, an eventual 10% survey of buildings highlighted that poor maintenance was a primary cause of concern.[3] This led residents to mistrust statements from officers and ward councillors. Indeed, even a judge stated she 'felt uneasy' about financial information presented by Lambeth.[4]

1 Lambeth Council, 'Homes For Lambeth Business Plan', 2019, http://estateregeneration.lambeth.gov.uk/business_plan_2019_20, p. 15.
2 Tom Keene, *Database (e)State*, 2019, www.db-estate.co.uk/about.html.
3 Tall Consulting Structural Engineers, *Cressingham Gardens Estate Structural Report*, 2013, www.whatdotheyknow.com/request/219718/response/686941/attach/3/Cressingham%20Gardens.pdf, p. 7.
4 *Bokrosova v. London Borough of Lambeth, Royal Courts of Justice, 3-4 November 2015*, via British and Irish Legal Information Institute (BAILI), 24 November 2015, www.bailii.org/ew/cases/EWHC/Admin/2015/3386.html, para 86.



Fig. 1. Caryl Mann, View of Cressingham from my back garden gate, 2014.[5]

In 2014, a *Lambeth Labour Party*[6] manifesto pledge to build 1,000 council homes in the borough prompted plans to build 464 homes in place of Cressingham's 306. However, of these additional 158 homes, the majority are for high-value private sale or rent, with only 27 targeted for council rents.[7] In other words, Lambeth's proposals primarily feed a private housing market – a germane point considering officers have kept around 30 council homes on Cressingham empty since 2018 while they progress their plans.

Lambeth's consultation excludes those without time or expertise to participate. Contributors to the *Save Cressingham* campaign (henceforth @SaveCressingham), for instance, have attended consultation workshops, given speeches at cabinet meetings, held marches, submitted over 300 Freedom of Information Act requests, assessed complex financial documents, and instigated two judicial reviews (won one, lost one), and developed alternatives to demolition.[8] The effort to understand and influence a multitude of technical, legislative, democratic, and party political processes is immense, yet Lambeth's decision to demolish Cressingham stills stands.

In the UK, affordability and access to housing is a pressing social issue, though government proposals to address these problems through urban regeneration led by private investors or local authorities have proved highly controversial. The 2017 Grenfell Tower fire tragedy brought the democratic and deliberative practices of central and local government into sharp focus, as did long-running housing campaign groups such

5 Reprinted with permission from the photographer.

6 Lambeth Labour Party, *Lambeth Labour Manifesto*, 2014, http://d3n8a8pro7vhmx.cloudfront.net/labourclp132/pages/59/attachments/original/1397750146/LambethLabourManifesto.pdf, p. 15.

7 Lambeth Council, *Investing in Better Neighbourhoods and Building the Homes we Need to House the People of Lambeth - Cressingham Gardens Estate,* 2016, https://moderngov.lambeth.gov.uk/documents/s80093/Cabinet%20Report%20-%20March%202016%20v8.pdf, p. 1.

8 Cressingham Gardens Residents, *The People's Plan*, 2016, www.cressinghampeoplesplan.org.uk/docs/TPP.pdf.

as @SaveCressingham, *Focus E15 mums*, and the *Southwark Notes*. Central to these practices are database technologies used in the management of council housing stock. Such databases, however, are unacknowledged, poorly understood, and mostly invisible and inaccessible to residents.

Artist and Activist Research

I devised strategies of *artist and activist led research* (henceforth research) to engage with the democratic, ethical, material, and intrapersonal implications of Lambeth's database technologies. My approach finds its root within a Critical Technical Practice proposed by the computer scientist turned theorist Phil Agre[9] and further developed within Goldsmiths University of London Cultural Studies department between 2007–2017.

My research draws from all aspects of my life: artist, activist, programmer, academic, husband, father, and resident facing the demolition of my home. As such, I identify each site as a valid location of research to provide different registers, or modes of reasoning, to consider how a world underwritten by data management technologies changes how I think and act. Importantly, I hold acts of theoretical research, making, programming, and activism in equal measure.

The technical register elucidates what the *relational database* does, which is a particular type of database used in Lambeth. In his landmark 1970s paper, E.F Codd is considered to have produced the first formal definition of the relational database, known as the *relational model*. The relational model introduced an abstract three-layer database architecture that separates how data is stored (internal), a database is structured (conceptual), and data is viewed (external). Codd's aspiration that '[f]uture users of large data banks must be protected from having to know how the data is organized in the machine' now means that non-technical users can work with databases.[10]

These abstract technical descriptions seem far removed from the management of a social housing estate such as Cressingham. However, these details produce particular arrangements of humans, computational machinery, and work environments. The relational model allows a Graphical User Interface (GUI) to access remote data-storage via database queries (a programming language called SQL) that can retrieve, sort, update, or delete data. A *database schema* describes a predictable structure for SQL to operate on in the form of tables, columns, data-types, and primary keys. These components mean that humans in Lambeth can simultaneously access the same data-set from any location with a network connection. Put another way, Lambeth's housing and other services are organized around an abstract relational model.

9 Philip Agre, '*Toward a Critical Technical Practice: Lessons Learned in Trying to Reform AI*', in Geoffrey Bowker, Les Gasser, William Turner, Susan Leigh Star (eds) *Social Science, Technical Systems and Cooperative Work: The Great Divide,* Mahwah, NJ: Erlbaum, 1997.

10 Codd, Edgar, 'A Relational Model of Data for Large Shared Data Banks', *Communications of the ACM* 13.2 (June 1970): p. 377.

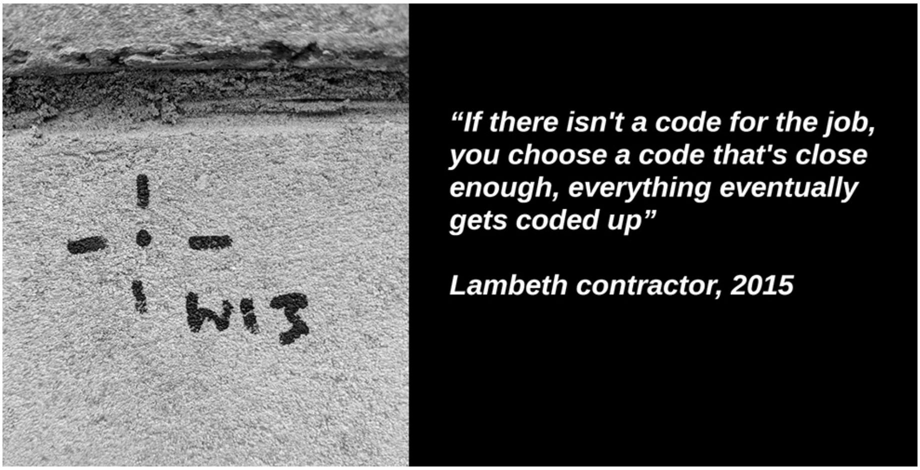


Fig. 2. Tom Keene, montage of a quote and surveyors mark on Cressingham, 2018.

The edges of Lambeth's databases are not clear because they are abstract, spatially distributed, operate through network infrastructure, and have changing sets of associations. Lambeth's primary housing database *Northgate*, for instance, manages the work of surveyors, contractors, officers, and call-centre staff in multiple locations across London and the UK. As such, Northgate is distributed across multiple hand-held devices, laptops, desktop computers, and servers. Furthermore, Northgate connects with stock condition and document databases in Lambeth, while also referencing the Land Registry and Ordnance Survey databases of central government. These associations make Northgate and other databases a difficult beast to figure.

Arts techniques, such as the montage in fig. 2, introduce an important register to address the ambiguous layers and associations of database systems. I coined the fictional title and acronym Housing Asset Repairs Management Systems (HARMS), to account for anything that *felt* (an intrapersonal observation) part of a database. HARMS was inspired by my art project *Aristotle's Office*[11] that employed the acronym OAP to describe a hidden communication protocol between technical objects of a certain age. HARMS resonates with the call of software studies scholars Matthew Fuller and Andrew Goffey to consider the evil in administrative technologies[12] and also with Adrian Mackenzie's observation that technologies are difficult to codify, symbolize, or quantify.[13] In essence, HARMS acts as a reminder, with intentional black humor, that databases can cause misery, distress, and have ambiguous associations.

11 Tom Keene and Kypros Kyprianou, 'Aristotle's Office', in Allan Seal, Susan Keene and Jonathan Bowen (eds) *EVA London 2009: Electronic Visualisation & the Arts,* Proceedings of a conference held in London 6-8 July 2009, BCS, 2009, pp. 285-7.

12 Matthew Fuller and Andrew Goffey, *Evil Media*, Cambridge, MA: MIT Press, 2012.

13 Adrian Mackenzie, *Wirelessness: Radical Empiricism in Network Cultures*, Cambridge, MA: MIT Press, 2010, p. 5.

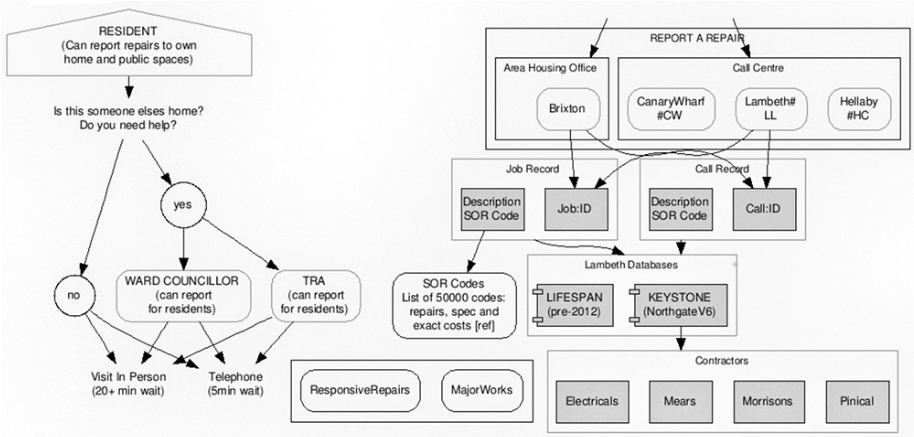


Fig. 3. Tom Keene, My failed attempt to diagram Lambeth's databases, 2016.

Philosophical theories of technology provide another register. The French philosopher Gilbert Simondon's 1958 concept of a *technical object* articulates Lambeth's databases as evolving process with many components, rather than a static entity.[14] Simondon's reformulation of what a technical object is better articulates HARMS than any technical diagram I have attempted to make (fig. 3). Furthermore, Simondon's concept of *technicity* helps articulate how components of Lambeth's databases have technical characteristics (their *technicity*) that governs what they and other components can do.[15] The artist and theorist Graham Harwood draws from Simondon in his concept of a *relational machine* to describe the collective endeavor of humans and machines to systematically gather information.[16] Here, Harwood recognizes humans as integral components of a database, and in doing so, introduces a radically expanded understanding of what a database is comprised of.

While it might seem strange to consider humans as components of machines, it is typical to describe ourselves as cogs within corporate or political machines. It is this sensibility that I apply to officers, contractors, and councillors, that all mediate how HARMS operates. Put another way, human-technical components of HARMS combine into a juggernaut of urban regeneration that appears hell-bent on the destruction of homes and community – a demolition machine that rides roughshod over the lives of Cressingham residents.

The components of HARMS collectively produce knowledge of Cressingham while acting on buildings and residents. Here, the French philosopher Michel Foucault's concept of power/knowledge helps articulates this as a process of displacement and transposition[17] or, drawing from

14 Gilbert Simondon, *On the Mode of Existence of Technical Objects*, trans. Cecile. Malaspina and John Rogove, Minneapolis: Univocal Publishing, 2016.

15 Gilbert Simondon, *On the Mode of Existence of Technical Objects*, trans. Cecile. Malaspina and John Rogove, Minneapolis: Univocal Publishing, 2016, p. 72.

16 Graham Harwood, *Database Machinery as Cultural Object: Art as Enquiry*, Sunderland: University of Sunderland, 2015, p. 18.

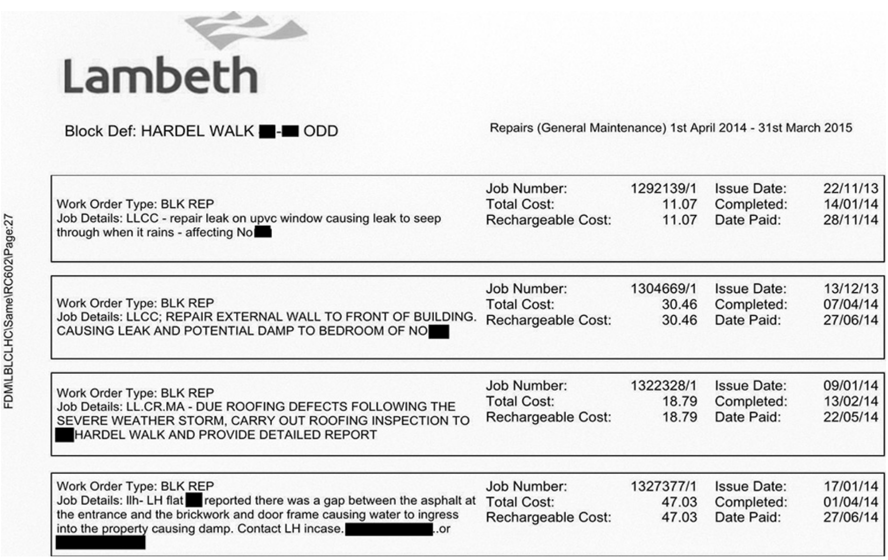
17 Michel Foucault, *Power/Knowledge: Selected Interviews and Other Writings, 1972-1977*, trans. Colin Gordon, New York: Pantheon Books, 1980, p. 69.

Harwood, as a kind of performance of power/knowledge.[18] Crucially, power/knowledge questions an understanding of power as something that can be held by those in positions of authority. Instead, power/knowledge considers how the components of HARMS collectively mediate the ways that specific configurations of power and knowledge come into being. Here, strategies of making and thinking with Lambeth's databases reveal how this performance plays out through the homes and lives of us Cressingham residents.

The Service Charge Parser

In computing terms, to parse something is to analyze text into logical syntactic elements. When I read my service charge statement (henceforth bill), it is an act of parsing, of breaking it down so that the processes and components that created it can more easily be understood. Living for many years at Cressingham, I, like most other residents, paid these bills without question. The charges *felt* about right, so we did not notice the details. However, as our bills started to rise and the quality of repairs reduced, we paid more attention. Residents felt a shift in HARMS as it transformed from a machine of repair to one of demolition.

My bill is a material manifestation of one or more databases within Lambeth (see fig. 4). As such, working with this bill provides insight into an otherwise hidden database schema and the technicity of the relational database. The bill lists repairs to my block, displaying terms such as *Block Def*, *Job Number*, *Work Order Type*, *Job Details*, *Issue Date*, and *Completed*. These terms reference the structure of an inaccessible database with primary-keys that define a unique reference for specific rows of data. This reference system provides the basis of the many-to-many relationships (any row can refer to any other) that are are the defining characteristic of the relational model.


Lambeth

Block Def: HARDEL WALK [redacted]-[redacted] ODD

Repairs (General Maintenance) 1st April 2014 - 31st March 2015

FDMILBLCLHC\Same\RC602\Page:27

Work Order Type: BLK REP
Job Details: LLCC - repair leak on upvc window causing leak to seep through when it rains - affecting No[redacted]

Job Number:	1292139/1	Issue Date:	22/11/13
Total Cost:	11.07	Completed:	14/01/14
Rechargeable Cost:	11.07	Date Paid:	28/11/14

Work Order Type: BLK REP
Job Details: LLCC; REPAIR EXTERNAL WALL TO FRONT OF BUILDING. CAUSING LEAK AND POTENTIAL DAMP TO BEDROOM OF NO[redacted]

Job Number:	1304669/1	Issue Date:	13/12/13
Total Cost:	30.46	Completed:	07/04/14
Rechargeable Cost:	30.46	Date Paid:	27/06/14

Work Order Type: BLK REP
Job Details: LL.CR.MA - DUE ROOFING DEFECTS FOLLOWING THE SEVERE WEATHER STORM, CARRY OUT ROOFING INSPECTION TO [redacted]HARDEL WALK AND PROVIDE DETAILED REPORT

Job Number:	1322328/1	Issue Date:	09/01/14
Total Cost:	18.79	Completed:	13/02/14
Rechargeable Cost:	18.79	Date Paid:	22/05/14

Work Order Type: BLK REP
Job Details: llh- LH flat [redacted] reported there was a gap between the asphalt at the entrance and the brickwork and door frame causing water to ingress into the property causing damp. Contact LH incase. [redacted] ..or [redacted]

Job Number:	1327377/1	Issue Date:	17/01/14
Total Cost:	47.03	Completed:	01/04/14
Rechargeable Cost:	47.03	Date Paid:	27/06/14

Fig. 4. Tom Keene, Extract from my service charge bill, 2016.

18 Harwood, Graham, *Database Machinery as Cultural Object: Art as Enquiry*, Sunderland: University of Sunderland, 2015, p. 25.

Resp			2.3 **Drainage**			
Resp	GRD041	PR4	GULLY:RENEW GRATING	IT	15.27	£10.79
Resp	GRD043	PR3	MANHOLE:RENEW MANHOLE COVER/FRAME	IT	80.26	£56.70
Resp	GRD045	PR3	MANHOLE:REPAIR MANHOLE COVER/FRAME	IT	21.79	£15.39
Resp	GRD047	PR1	DRAIN:CLEAR BLOCKAGE TO GULLY/DRAIN	IT	13.13	£9.28
Resp	GRD049	PR3	DRAIN:CARRY OUT CCTV SURVEY	IT	157.50	£111.27
Resp			3.0 **Bricklayer**			
Resp	BWK001	PR4	WALL:REBOND FRACTURED BRICKWORK / BLOCKWORK	IT	96.54	£68.21
Resp	BWK002	PR4	WALL:REBOND FRACTURED BRICKWORK / BLOCKWORK HELIE	IT	134.80	£95.24
Resp	BWK003	PR4	WALL:REPOINT BRICKWORK / BLOCKWORK	IT	42.57	£30.08
Resp	BWK005	PR4	WALL:RENEW DAMAGED OR PERISHED BRICKS / BLOCKS	IT	52.60	£37.16

Fig. 5. Tom Keene, list of SOR codes obtained via a Freedom of Information Act request, 2018.

As a primary-key, Job Numbers wield a surprising amount of power/knowledge. Each Job Number identifies a row of data with references to other tables or databases. These references include *Schedule of Rates* (SOR) codes, which, as I discovered through a conversation with a contractor, define agreed costs between contractors and Lambeth (see fig. 5). When staff create a new job on Northgate, they select a *Job Type* (e.g. drain, brickwork) from a list that defines a relationship between Job Numbers and SOR codes. These many-to-many relations connect officers, contracts, contractors, residents, and their homes. That is to say, primary-keys establish relationships both inside and outside the technological confines of the database.

Many-to-many relations within Lambeth's databases are connected to ethical decisions to demolish peoples homes. For example, a count of Job Numbers associated with Cressingham (*Estate ID* EA037) and drainage repairs (SOR's GRD041, GRD043, GRD045, GRD047, GRD049) can indicate a high number of drainage issues. However, it is easy to forget that such representations can be misleading. During a repairs tribunal, for example, a housing officer confirmed that a majority of drainage issues on Cressingham should have been the responsibility of Thames Water, which inflated Lambeth's repairs costs. Notably, it took years of resident effort and then legal proceedings to contest this data, which questions the validity of a democratic process that is shaped by such metrics.

The successful challenge of a bill requires the situated and expert knowledge of residents and others. To this end, leaseholders on Cressingham hold annual meetings to jointly read our repair bills. At one meeting, a quantity surveyor taught us to recognize common mistakes in data and tactics by contractors to inflate repair costs. With these new skills, we identified around 200 repairs that lacked sufficient detail to warrant payment, had been charged for twice, had not been claimed on insurance, or were not completed. These issues prompted the group to inspect every suspect repair job, which is no small task.

A computational process optimizes the ways that I and others can work with data. It can take days of effort to copy data from multiple bills into a spreadsheet. As such, my background as a programmer prompted me to automate and optimize this process. I used the Python programming language to scan paper documents or convert each page of a PDF (Portable Document Format) bill into a series of JPG (Joint Photographic Experts Group) images. The code employs *Computer Vision* techniques to identify separate fields of data based on their location. Then *Optical Character Recognition* machine-encodes these image-locations into strings of text. Finally, the code combines these text strings into singles lines appended to a CSV (Comma Separated Value) file.

The relational model shifts the labour of inspecting repairs from housing officers to residents. It also shifts associated power/knowledge dynamics. The *completed* field of my bill, for instance, triggered my investigation into Lambeth's quality assurance methods, revealing officers only inspect 1% of repairs. Here, the completed field works as a binary marker to monitor repairs and indicates a *permissions* structure where contractors can mark their own work as satisfactory and complete. Residents, however, have no such permissions except through a long-winded call-centre and complaints process that, in my experience, effects little change.

The Service Charge Parser is a human-technical process that creates new possibilities of association and action. The code, for example, generates a CSV file that can be read by spreadsheet software, where previously PDF or paper documents could not. The new format means that residents can add items to an ever-expanding list and perform calculations on costs. These additional affordances alter how and where people can work with data. While these observations might seem banal and everyday, they highlight how components of HARMS like PDFs slow down and exhaust residents into inaction, while reformatting data into CSV files, for instance, equips and energizes them.

Banal acts of categorization produce an asymmetry of power/knowledge that privileges one group over another. Creating the Service Charge Parser, for example, produced a startling realization. While I visually inspected repairs on Cressingham, tenants informed me that they did not receive service charge statements because repair costs are included in their rental payments. Furthermore, because this data identifies individuals and their homes, Lambeth refuses to provide this information via FOI requests. This means that tenants are at a disadvantage because, unlike leaseholders, they cannot effectively audit repair data.

Accelerations

The relational model is an essential component of local authority housing that optimizes and distributes the ways that humans think and act. It is difficult to imagine, for example, how Lambeth could manage their 140,000+ annual maintenance jobs without a relational database of some kind. However, while the relational model clearly helps Lambeth to cope with huge volumes of data, it also configures layers of government, contractors, and sub-contractors that produce that data in the first place. The 31 million documents and 336 companies of interest identified by police in their investigation of Grenfell provide a clear illustration of this.

I argue that this relational model configures and accelerates the marketization of housing services. The urban geographer Stuart Hodkinson describes this local authority world of repair, maintenance, and urban regeneration as an environment of private profit-seeking cartels that have cut quality and casualized workforces.[19] This environment is optimized and accelerated by conflations of database technologies, network infrastructure, and metrics that residents have little recourse to alter or contest. Crucially, these metrics and data-structures exclude a lived experience that questions the validity of both data and a participatory democratic process.

19 Stuart Hodkinson, *Safe as Houses: Private Greed, Political Negligence and Housing Policy after Grenfell*, Manchester: Manchester University Press, 2019, p. 29.

Acts of programming, activism, and theoretical research reveal a myriad of processes that occur between a resident reporting a repair, a bill arriving in the post, and decisions to demolish peoples homes that break-up communities. These strategies reveal how the sheer volume of information that databases produce makes it difficult for residents to hold anybody to account. As such, it is not enough to change individuals, legislation, or party politics to produce a more safe and egalitarian version of urban regeneration. Rather, we must also change the technical systems and our symbiotic relationship to them to produce different outcomes.

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Destandardizing Design? Learning from Critical Users

Deanna Herst

DESTANDARDIZING DESIGN? LEARNING FROM CRITICAL USERS

DEANNA HERST

> The stakes are high. The next generation of engineering prosthetics can't only be in high-tech innovation and technology. Building a desirable future depends on multiple voices and varied forms of expertise. It depends on engineering with unlikely people, with unlikely things, and with an expansive view.
>
> - *Sara Hendren and Caitrin Lynch, Unlikely Engineering Manifesto*[1]

The *Unlikely Engineering Manifesto* by designer Sara Hendren and anthropologist Caitrin Lynch resulted from 'Engineering at Home', an initiative from a woman called Cindy, who became a quadruple amputee after a heart attack. Unable to perform simple everyday life tasks, like eating a sandwich or applying makeup, Cindy decided to make her own adaptations to her utensils. She self-engineered tools like a hand cream jar opener and a device to hold scissors, resulting in a repository of add-ons for her personal habits and daily routines.

These unlikely, quirky objects implicitly represent her frustration towards standard medical products that provided insufficient support for her practical needs. Contributing to her story, Hendren and Lynch published the *Unlikely Engineering Manifesto*. It is a call for engineers and designers of medical products to rethink systems, workflows, and standards in order to develop devices that respond to the real needs of individuals with disabilities. From a human focused perspective, their view questions processes that are predominantly technologically driven. For this reason, the manifesto calls for interdisciplinary collaborations with professionals from fields like anthropology and – not least – with the users of these technologies.

Frustrating Designs, Unruly Use(r)s

Whether in health care or other sectors, mass-produced products for people with disabilities often fail to meet the diversity and complexity of the user's needs. In some cases, adapted designs signal 'otherness' too explicitly, risking stigmatization. IKEA's initiative *ThisAbles,* for example, targets people with 'special needs' with unambiguously titled add-ons like 'cane by me' or 'easy handle'.[2] Addressing such a complex group as universal, with standard solutions for all, overlooks the core of the problem: the lack of diversity in needs, gestures, movements, and habits.

How can we *destandardize* design for those people – people with disabilities, for instance – who are not catered to by universal industrial norms? Is it possible to develop products for

1 Sara Hendren and Caitrin Lynch, 'This Counts Too: Engineering at Home', *Unlikely Engineering Manifesto*, 17 January 2016, http://engineeringathome.org/manifesto.

2 Ikea, *ThisAbles*, https://thisables.com/.

individuals in a mass-market economy? What could be the role of making and self-production for health care? *Engineering at Home* shows the potential of a *critical user*. Cindy's intimate, unruly looking tools reflect her private routines and embody her tacit critical response towards frustrating mass-produced products. Could Cindy be called a critical maker? According to Mark Ratto, 'critical making shares an emphasis on "values" with both critical design and other critical practices – such as the critical technical practice from which it derives as well as value-sensitive design and values-in-design'.[3] Looking at this project through the lens of values in Critical Making, Cindy represents a specific position. Her role as a maker is inseparably intertwined with her position as a *critical user*. As such, she is an expert in evaluating the ergonomics of her utensils and in adapting them to her own values, necessities, and experiences. Cindy's case shows the urgency of including a *critical user's* perspective in product development in order to adequately respond to the real needs of individuals with disabilities.

HUB: the Critical User as Self-fabricator

How can we position the *critical user* in the process of destandardizing design? Could unlikely processes and unruly looking products replace universal standards in mass-produced health care products? In the *Human Unification Base* (*HUB*) project, we apply these questions to the field of self-health care. We look at the role of the *critical-user-as-maker*, as an extended, more specific version of the critical maker. Especially within the context of people with disabilities, we feel this inclusive perspective is indispensable in Critical Making. Ratto discusses the significance of inclusivity related to how 'working-class people' and 'rural people' work with technology: 'We should be thinking about how that should be valued within critical making or could be folded into critical making – because if there is an important political agenda built into the maker movement, then that agenda should be made available more widely than to the cultural elite'.[4]

HUB is an initiative of interaction designer Eric Groot Kormelink, who has been a wheelchair user since birth. Eric became aware of his potential as a critical-user-as-maker at FabLab Amsterdam, where he developed a caterpillar modification for his wheelchair to increase his ability to access public spaces. Before that, like Cindy, he re-engineered his own utensils, like an adapted fork he uses every day for multiple purposes, because none of the standard tools enabled him to eat in a convenient way. However, his adaptations are not merely functional solutions. They are derivatives of his profound needs: freedom to move around independently. His experiences in everyday life – encountering inaccessible situations in public space, transport, buildings, and other frustrating designs – prompted him to initiate *HUB*.

The project in formation focuses on the empowerment of people with disabilities, explicitly drawing on the projects of these critical users.

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3 Matt Ratto, 'Critical Making' in Bas Van Abel, Lucas Evers, Peter Troxler, and Roel Klaassen (eds) *Open Design Now: Why Design Cannot Remain Exclusive*, Amsterdam: BIS Publishers, 2014, http://opendesignnow.org/.

4 Garnet Hertz (ed.) *Conversations in Critical Making*. Victoria, BC: CTheory Books, 2015: pp.16.



Fig. 1. Eric Groot Kormelink, Fork*, customized fork, year unknown.*



Fig 2. Eric Groot Kormelink, Caterpillar track, 2011.[5]

5 Images reprinted with permission of the creator.

This is of fundamental importance in times when the Dutch health care system is increasingly withdrawing. Although the trade-offs of self-care – like redirecting the responsibility to users – are debatable, self-care is becoming increasingly urgent. Coinciding with self-care is the increased availability of digital fabrication technologies, allowing people to 'self-fabricate'. But how accessible are these tools for people with disabilities?

In this context, *HUB* explores the value of DIY / DIWO making, open design, the realistic potential of digital fabrication for this group, and the possible benefits of *in situ* prototyping and testing. It aims to rethink health care devices and remake them in collaboration with makers, designers, artists, engineers, care and other professionals by sharing experiential and technological knowledge. To destandardize design instigated by individuals with disabilities, we investigate a broad spectrum of scenarios, from the user's perspective to that of the maker/designer/engineer. A future objective is to develop prototypes into real products, create new standards and find markets. Each activity focuses on personalization, 'because no user is the same'.[6]

The Ergonomic and Beyond

But what does personalization mean when we look beyond the obvious ergonomic needs and try to unravel the question behind the functional solution? Flying wheelchairs, steampunk leg prostheses, and Lego robot arms are but a few examples that show the imagination of *critical-users-as-makers* beyond the ergonomic. What exactly are values in Critical Making, whose values are they, and how can we become aware of them? In *HUB*, we draw upon the Convivial Toolbox by design researchers Sanders & Stappers, investigating ways to disclose these invisible, unspoken, latent layers in order to make more relevant products, tools, or devices.[7] We work with open design, less from its technological perspective (how accessible are open source, digital fabrication tools?) but moreso as a method to invoke the user's involvement. Our point of departure is an analysis of former open design projects developed at the Willem de Kooning Academy (WdKA) in Rotterdam, the Netherlands.

One open design project is *Blindly Organized*, a system for organizing personal belongings that transforms into a bag. Sophie Dirven's goal was to share organizing knowledge from visually impaired people with chaotic-minded people in need of structure. In an elderly home, she met a woman who was gradually losing her sight. By sharing intimate stories and observing her everyday habits, Dirven developed a close collaboration, gaining deep insight into her personal life. Besides the woman's functional needs, like distinguishing and organizing items in a bag, she also discovered her aesthetic preferences, colors, and shapes. She applied this to the design of a colorful, modular bag system and disseminated it online for adaptation. *Blindly Organized* destigmatizes universal products for blind people: the specific needs from a visually impaired woman have now been made relevant for everybody. By relating to shared needs, she set a new standard for bag design: 'Because after all, everyone is blind in their bag'.[8]

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6 HUB mission statement, Amsterdam, 2018.

7 Elizabeth Sanders and Pieter Stappers, *Convivial Toolbox: Generative research for the front end of design*, Amsterdam: BIS Publishers, 2012.

8 Sophie Helene Dirven, *Blindly Organized,* https://blindlyorganised.wdka.nl/.



Fig 3. Sophie Dirven, Blindly Organised, *bag, 2018.*[9]

9 Image reprinted with permission of the creator.

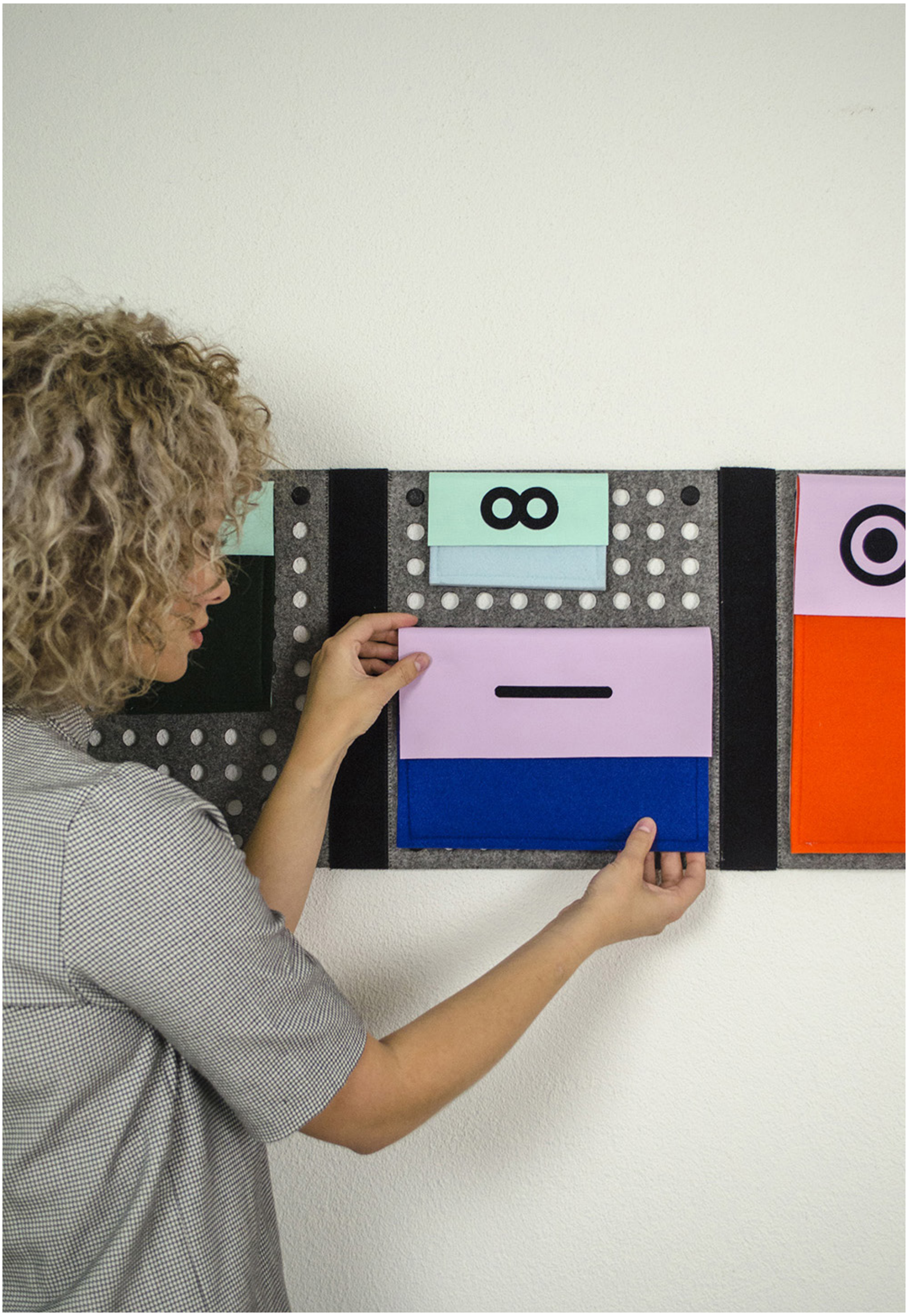


Fig 4. Sophie Dirven, Blindly Organised, *system, 2018.*[10]

10 Image reprinted with permission of the creator.

Uncertain Forms

Engineering at Home and *Blindly Organized* represent two different positions towards destandardizing design. The first project originated from a *critical-user-as-maker*, who used DIY-engineering to realize personal ergonomic solutions. The second project reflects an open design process initiated by a designer who used story sharing to discover the visually impaired woman's needs and values. In *HUB*, we focus on user driven DIY/DIWO and open design from the perspectives of both the maker-designer and the user-as-maker. Open design becomes essential in a context where products need to be adaptable to meet specific requirements. To address the invisible needs of individuals with disabilities, we investigate the aesthetic dimension of open design through the concept of the open form. In *The Poetics of the Open Work*, Umberto Eco describes this as: 'The poetics of the "work in movement" (and partly that of the "open" work) sets in motion a new cycle of relations between the artist and his audience, a new mechanics of aesthetic perception'.[11] In *The Fine Mechanics of the Open Form* (1988-1992), composer and theater maker Dick Raaijmakers employs the open form as an approach to facilitate improvisation and chance in electronic music. Within this context, he describes the open form as a critique of the closed nature of technology and the closed structures of classical compositions.[12] Although situated in a different field, this *closed nature* is not unlike the mechanisms of the health care industry.

Employed in participatory processes, the open form inevitably results in uncertain or unexpected outcomes. As Liesbeth Huybrechts states in *Participation is Risky*: 'Since participatory projects rely on the input from both makers and participants, they are never finished. Their process and "final" form is inherently undefined, which may lead to a feeling of uncertainty among makers and participants'.[13] At WdKA we sought to address this possible tension between designers and their users, experimenting with the open form as a prompt for activation and interaction. We worked with the Surrealist *cadavre exquis* (exquisite corpse), a playful system for intuitive collaboration in which a drawing or poem is completed by others. Exploring this open system for collaborative making resulted in unexpected outcomes, like a 'Frankenstein' cardigan from various patches knitted by different people. The assignment *Design Autopsy* reflected a more radical approach. Students dissected an electronic device, redesigned it, and gave it a new purpose based on personal needs. This process of rethinking and remaking resulted in unfamiliar products, like a steaming clock made from a rebuilt humidifier. In *HUB*, we are interested in further examining the value of these open formats and collaborative processes, together with their unexpected results, and the ways they might relate to accessibility in health self-care products.

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11 Umberto Eco and Anna Cancogni, *The Open Work*. Vol. 2. Cambridge, MA: Harvard University Press, 1989, p. 22.

12 Arjen Mulder and Joke Brouwer (eds) *Dick Raaijmakers: Monografie*. V2_Instituut voor de Instabiele Media, 2007.

13 Liesbeth Huybrechts et al., *Participation is Risky. Approaches to Joint Creative Processes*. Vol. 13. Valiz: Amsterdam, 2014, pp. 12.

Aesthetic Provocations

Besides the open form, at WdKA we explored attitudes like confrontation and provocation as tactics for story sharing in artistic research. *Confrontation Piece* is an approach deriving from the *cultural probe* in interaction design as popularized by designers and design scholars Bill Gaver, Tony Dunne, and Elena Pacenti: 'a means of gathering data about people's lives, values, thoughts. Probes can be any sort of artifact (map, postcard, camera, object, diary, etc.) along with evocative tasks, which are given to participants to allow them to record specific events, feelings, or interactions'.[14] The *Confrontation Piece* challenged students to test their prototypes through unexpected interventions or unfamiliar objects. It was used in *Secret Stories about Hidden Local Crafts*, an assignment that aimed to collect narratives from local craftspeople. One project focused on forgotten weaving techniques. Students installed a huge public loom at the local market, using this provocative form to incite stories about weaving. While the giant loom succeeded as a tool for collecting narratives, these tales were less about weaving and more about everyday lives. This unexpected outcome changed the loom's original function, transforming it into a public storytelling tool.

In the next piece, we expanded the user-oriented *Confrontation Piece* with a more speculative approach. *Provocation Piece* tests extreme scenarios in real life through a provocative design that aims to unlock the hidden values within a target group. In an assignment about a future Internet of Things, students worked with several interventions, from roleplay to proposing alienating objects. The project *Itranscom*, for example, was aimed at future care. What if we could get access to the thoughts of people who cannot communicate anymore, for example, because of dementia? The student made a prototype of a data transmission system, a small, flickering electronic object, which she used in interviews with patients. The object sparked profound conversations about care, life, and death. It convinced one person to reveal her fear around privacy, which became embedded in the final design. It is an example of how a provocative approach enables designers to detect the user's latent fears – in this case, towards unfamiliar electronic devices.

In the projects mentioned, we used a speculative approach to discover hidden values and emotions. However, speculation was not addressed in isolation, as an expression of authorship or design for debate as discussed in Anthony Dunne and Fiona Raby's work,[15] but rather connected to real-life needs. Drawing on interaction designer Ahmed Ansari's inclusive view on design, we expanded the *what if* scenarios with the question *how else*. As Ansari explains: 'How else emphasizes a connection to current systems and structures where the principle project is framed not as an aesthetic, exploratory, intellectual exercise, but as a political, transformative, active enterprise'.[16] Investigating this *what if/how else* scenario allows us to connect imaginative scenarios about desired futures with the real life requirements of individuals with disabilities.

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14 Bill Gaver, Tony Dunne, Elena Pacenti, 'Design: Cultural Probes', *interactions*, *6*(1), 1999, pp. 21-29.
15 Anthony Dunne and Fiona Raby, 'What if...', http://dunneandraby.co.uk/content/bydandr/496/0.
16 Ahmed Ansari, 'Design must fill current human needs before imagining new futures.', MIT Media Lab Summit, July 2015.

The Imaginary in Self-Health Care

One of *HUB*'s questions relates to maintaining the user's central position in the design and making process. As Eric states: 'it is necessary that health care developers, designers, and engineers postpone solution thinking and start investigating the real values behind the obvious questions related to functionality or limitations'.[17] But what are those real values? To find out 'the real question behind the need', we focus on the tacit, non-explicit requirements of people with disabilities that sometimes extend beyond the ergonomic. What could be the role of the imaginary in the exchange between user and maker/designer?

Elaborating on artistic research methods, strategies and tactics developed at WdKA, we propose approaches like speculation in real life, provocation to incite storytelling, open-ended forms to encourage individual adaptations, and scenarios for unimaginable futures. Some preliminary scenarios include:

The Poetics of Use: using different forms of narration to discover personal narratives, memories, and other personal responses to everyday life devices. One example of story sharing, already discussed, is the *Blindly Organized* system for the visually impaired woman.

Stories of the Senses: investigating the role of the senses and sensory feedback on products. Which tactile, olfactory, visual, auditory, or taste-related sensations are desired or missed in daily life products? For example, if Eric needs a straw to drink his beverages, how can his experience of different drinks be enhanced through the structures of the straw?

Imaginary Interactions with (Technical) Things: an autopsy of inaccessible devices for people with disabilities. What unintended gestures or habits do these discouraging devices generate? How can we dissect and redesign the (interaction) design of a device like a PlayStation controller for a smoother experience?

As shown in earlier projects, we expect unpredictable outcomes – objects or add-ons that are quirky, unfamiliar, or unusual, but that nevertheless reveal more profound preferences or emotions. Could these unruly parameters become future standards for self-health care?

Radical Inversions

A more rigorous approach involves performativity and role inversions. What if a designer, in a monitored situation, traded places with a wheelchair user to learn what it means to live with a disability? Designer Patricia Moore experimented with this kind of experiential research. For many years, she disguised herself as an elderly woman to understand the seniors' everyday life.

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17 Personal communication with Eric Groot Kormelink, September 2018 - March 2019.

Or what if the *critical-user-as-maker* were in charge of the design cycle, by defining the rules, materials, technologies, and execution, creating an inverted version of *Conditional Design*?[18] In this scenario, it is the user who defines the design parameters for the designer, not vice versa. There are already many semi-finished works waiting to be completed, like Eric's caterpillar tire. As an unfinished *un-readymade* embodying personal desires, it is a valuable reference. Similar to the *cadavre exquis*, an *un-readymade* like the caterpillar add-on represents a starting point, establishing the standard for further development by makers, engineers, or designers, and encouraging them to learn from the *critical-user-as-maker.*

Besides role inversions and collaborative *un-readymades*, we also imagine scenarios of the unimaginable: those presumably impossible inventions that *critical-users-as makers* dream about. We picture cases like the flying wheelchair, intuitive guitar interfaces, additional limbs that do not yet exist, or Frankenstein add-ons to make digital fabrication tools more accessible. To realize these visions, establishing a network with a broad spectrum of experts is an urgent first objective.

Conclusions

Could *critical users* become proverbial 'game changers' and destandardize the health care industry? Departing from the role of values in Critical Making, for self-health care we feel that it is necessary to expand its context with the *critical-user-as-maker*, an expert referent and valuable storyteller who has experienced frustrating standardized products. As the *Unlikely Objects Manifesto* proposes, interdisciplinary collaborations between professionals from technology, engineering, health care, and anthropology are indispensable. However, to go beyond ergonomic problem solving and learn about tacit needs – the real question behind the needs – the experience and imagination of both individuals with disabilities and makers, artists, or designers are of equal importance. Borrowing from open design approaches at WdKA, *HUB* intends to further investigate the value of the imaginary in collaborative making, to discover the invisible, unspoken needs of people with disabilities. Working from this hyperpersonal perspective introduces parameters like undefined processes, unexpected outcomes, and unruly products. It is the goal of *HUB* to work with these parameters and put the *critical-user-as-maker* in charge of her environment; as concept engineers, art directors, or innovative inventors. What if subjective variables like unlikely, undefined, unexpected or 'un-ready' became the new standards?

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Building Open Design as a Commons

Peter Troxler

BUILDING OPEN DESIGN AS A COMMONS

PETER TROXLER

The concept of Open Design has been embraced by numerous initiatives in design, from furniture to textiles, from product design to social design since its introduction in the early 2000s.[1] Open Design has also brought a revival to openness and sharing in technical domains such as hardware and electronics. Sharing design and production files and instructions has become an almost compulsory ingredient for projects and initiatives that aim to convey a critical dialogue on making, producing, and manufacturing the things that dominate the lives of 21st century city dwellers in the global North.

Open design has been proposed as the key ingredient to make and discuss circular products in events such as the 'Open Source Circular Economy Days'[2] and the 'POC21 Innovation Camp'.[3] Open design has become the preferred modus operandi for social design. Increasingly, open design inspires the design and manufacturing sectors and their related institutions. Premsela, (at the time) the Netherlands Institute for Design and Fashion,[4] was a key partner in publishing the volume *Open Design Now.*[5] In 2018, the Danish Design Centre ran a program for designers and manufacturers to grow their business 'by going open source'.[6] Open design, and research about open design, have predominantly been obsessed with the characteristics of open, legal frameworks that would facilitate the openness of design, the control that designers would need to relinquish, and the open access to design resources that everyone would receive.[7] However, less attention has been paid to how communities of multiple actors might self-organize in order to create, build, share, and preserve those open design resources.

In this article, we trace open design back to its roots and – by building on experiences from a recent open design initiative as well as research into open design practices – we relate the 'how to organize' question of open design to earlier theories of common, shared resources.

Open Design

According to Berlin-based designer Ronen Kadushin, open design employs two generative mechanisms:

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1 Berlin-based 'open' designer Ronen Kadushin received his M.Des. degree on Open Design in 2004 from Middlesex University, London.

2 Roberta De Angelis, *Business Models in the Circular Economy: Concepts, Examples and Theory*. Cham, Palgrave Macmillan, 2018. p. 25.

3 Adrian Smith, Mariano Fressoli, Dinesh Abrol, Elisa Arond, Adrian Ely, *Grassroots Innovation Movements*. London: Routledge, 2017, p. 1.

4 Since 2013, Premsela is part of the 'New Institute'.

5 Bas van Abel, Lucas Evers, Roel Klaassen, Peter Troxler (eds), *Open Design Now. Why Design Cannot Remain Exclusive,* Amsterdam: BIS publishers, 2011.

6 https://remodel.dk.

7 Étienne Boisseau, Jean-François Omhover and Carole Bouchard, 'Open-design: A State of the Art Review', *Design Science,* 4.3 (2018).

1. sharing digital design files on the internet under a license that allows re-use and modification of a design, and
2. creating designs that can be manufactured directly from the design files without the need for specialist machinery or tooling.[8]

Elsewhere, open design has been defined as 'design whose makers allowed its free distribution and documentation and permitted modifications and derivations of it'.[9] This definition has its roots in software. Rather than actually *defining* what 'open' is, this second definition sets out what the *consequences* of 'open' are.

Both definitions approach open design from the perspective of the designer as the author of a design who resigns the exclusive authorial rights of making commercial use of that design. Leon Cruickshank, professor of Design and Creative Exchange at Lancaster University, more succinctly defines open design as

> models based on giving things away (free revealing), mass participation in design, co-creation and a range of other approaches that seek to develop new open methods of creativity [...] not necessarily based on conventional business models and a market economy.[10]

Cruickshank's formulation adds two elements to the former definitions: the notion of 'mass participation' and the idea of deviating from conventional business models and a market economy. These two additions are crucial to the understanding and further development of open design. However, the guidelines Cruickshank develops for designers, design participants, and design facilitators remain restricted to the core process of creating open design. Questions about building, sharing, and preserving of open design remain unasked – and unanswered.

Mass Participation in the Danish Remodel Example

In 2018, the Danish Design Center started an initiative to introduce open source principles to manufacturers as an instrument to develop new business models. It was aptly named 'Remodel'. Eight Danish manufacturing companies followed the program.[11] Those eight companies came from a variety of industries: interior and furniture design, architecture, electronic devices and tools, but also food and biotechnology.

The program consisted of seven phases:

1. discovering open source
2. imagining going open

8 Peter Troxler, 'The Beginning of a Beginning of the Beginning of a Trend', in Bas van Abel, Lucas Evers, Roel Klaassen and Peter Troxler (eds) *Open Design Now: Why Design Cannot Remain Exclusive*, Amsterdam: BIS Publishers, 2011, pp. 108-115.

9 http://www.opendesign.org/odd.html.

10 Leon Cruickshank, *Open Design and Innovation: Facilitating Creativity in Everyone,* London: Routledge, 2014, p. 23.

11 Initially, the project started with ten companies, two of which left the whole program early.

3. visualizing user journeys
4. drawing a community and system map
5. community testing of the approach in a hackathon
6. further developing a community
7. prototyping the (new) product ecosystem

A recurring theme in the Danish Design Center's program was thus the idea that companies should involve 'the community' in their open source projects, a goal that corresponds to Cruickshank's notion of 'mass participation'. The companies indeed developed the desire, drive, and determination to identify 'somebody' (or some bodies) to contribute to the body of open design(s) their projects were built upon. Their approaches varied little, as all companies proposed some kind of online platform where variations of existing designs or new designs would be collected and exchanged in order to broaden the companies' offerings and to serve customers with more suitable solutions. Companies were split on who the participants of and contributors to these platforms would be – either designers (three companies) or customers (five companies). Designers would contribute to the product catalogue of the company owning the platform, thereby expanding its assortment, occasionally with the prospect that designers could earn royalties and benefit from exposure on the platform. Customers would document how they adapted existing products to their individual needs, therefore helping the companies to better adjust their products to customer needs. What is striking is that both versions had one aspect in common: the community, via the platform, would contribute primarily to the business of the platform's initiator. Only two of the eight companies mentioned any aspect of reciprocity in their proposals.

The Role of the Community

During the closing discussions of the Remodel initiative, a recurring topic was the idea of platform and community building. While all the participating companies included a platform where a community would meet in their proposals, they all struggled to imagine how to implement that strategy. The obvious solution participants at the closing suggested was some sort of community building and community management efforts to try to attract more engaged people to the open design project in question. The corresponding instruments mainly included attempts to make the community in question appear more desirable, more difficult to get access to, and other nudging and social engineering tactics. Echoing the absence of any reciprocity in the proposals, the obvious 'what's in it for me' question of prospective community members never arose in the discussion.

However, as earlier analyses by IT management researchers Bo Xu, Donald R. Jones and Bingjia Shao as well as work from design researcher Ali Gürcan Özkil have shown, the large majority of open design projects both in hardware and software have not attracted a

large number of contributors, i.e. they remained relatively inactive and dormant.[12,13] Indeed, Jérémy Bonvoisin and colleagues at the French-German research project 'OPEN! Methods and tools for community-based product development' noticed that even the open source hardware projects with the most active communities showed substantially less contributions than typical closed source, industrial projects.[14]

Another study by business and innovation scholars Laetitia Thomas and Karine Samuel suggested that successful open source projects in product design were community-centric. They emerged initially from the community in order to solve a problem experienced by the very same community. The community itself grew by attracting more talent to solve the problem.[15]

Community-based Business Models

Indeed, in a previous study I co-authored with Patricia Wolf, we pointed out that it is important to differentiate between *community-oriented* and *community-based* business models. Community-oriented models aim to extend a central firm's business model by interacting with a 'community' that typically consists of user-client-stakeholders, but these models suffer from the friction between the business imperative of maximizing profits and the community values of sharing and altruism.[16]

In that multiple case-study, we analyzed the business models of digital maker-entrepreneurs.[17] Digital maker-entrepreneurs are people who create designs digitally, share them on online platforms such as Thingiverse, employ digital manufacturing technologies such as 3D printing to produce them, and generally use these technologies as a generative mechanism for their entrepreneurial activities. We were particularly interested in the paradox between, on the one hand, the freely available designs that are supposed to be reproduced with readily available technology at marginal cost and, on the other hand, the people using those very designs to earn money. For this reason, we especially tried to locate participants on the platform who had built a successful business out of (re)using shared designs.

For the analysis we looked at business models as activity system, as suggested by management scholars Christoph Zott and Raphael Amit.[18] For the in-depth analysis we referred to

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12 Bo Xu, Donald R. Jones D R, Bingjia Shao, 'Volunteers' Involvement in Online Community Based Software Development', *Information & Management*, 46.3 (2009): pp. 151-158.

13 Ali Gürcan Özkil, 'Collective Design in 3D Printing: A Large Scale Empirical Study of Designs, Designers and Evolution', *Design Studies,* 51 (2017): pp. 66-89.

14 Jérémy Bonvoisin, Tom Buchert, Maurice Preidel, and Rainer G. Stark. 'How Participative Is Open Source Hardware? Insights from Online Repository Mining', *Design Science,* 4.19 (2018), https://doi.org/10.1017/dsj.2018.15.

15 Laetitia Thomas and Karine Samuel, 'Characteristics of Open Source Business Models', The XXVIII ISPIM Innovation Conference – Composing the Innovation Symphony, Vienna, 18-21 June 2017.

16 Patricia Wolf and Peter Troxler, 'Community-based Business Models. Insights from an Emerging Maker Economy', *Interaction Design and Architecture(s) Journal - IxD&A,* 30 (2016): pp. 75-94.

17 Peter Troxler and Patricia Wolf, 'Digital Maker-Entrepreneurs in Open Design: What Activities Make Up Their Business Model?', *Business Horizons,* 60.6 (2017): pp. 807-817.

18 Christoph Zott and Raphael Amit, 'Business Model Design: An Activity System Perspective', *Long*

activity theory as a framework which again uses activity as a unit of analysis.[19]

We analyzed three cases in detail: a web shop for 3D printed objects, a serial entrepreneur in 3D printing, and a hardware engineer who introduced 3D printing at work and later became an entrepreneur himself. The cases revealed that digital maker-entrepreneurs specifically described both their customers and their suppliers in terms of community. They also spoke about the relations within their firm in community terminology. The digital maker-entrepreneurs mentioned notions of 'co-creation' and 'co-ownership' and made references to community stewardship such as 'fairness' and 'reciprocity' – by giving credit when reusing designs, by freely sharing their own designs, and, for example, by implementing a revenue-sharing program.

These examples illustrate how business models emerge from the community itself and create value for the community. Øystein Fjeldstad and his colleagues suggested three success factors for such models:

1. actors who have the capabilities and values to self-organize;
2. commons where the actors accumulate and share resources; and
3. protocols, processes, and infrastructures that enable multi-actor collaboration.[20]

In line with the findings by Thomas and Samuel, we found that entrepreneurs emerging from such communities combined building blocks exhibiting altruism with building blocks covering basic costs in order to develop new, hybrid business models. We also found that those entrepreneurs employed novel governance principles such as reciprocity and fairness to guide their business activities.

Communities as Stewards of Open Design

Through studying new business models and organizational designs from an actor-oriented perspective, both our findings and Fjeldstad's observations point to new ways of doing

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Range Planning, 49(2-3) (2010), pp. 216-226.

19 In activity theory, activity is initiated by *subjects* acting alone or in groups and is directed at a certain goal, called *object*. The framework situates the activity at the center of an entire activity system. Beyond the subjects with their history, culture, and so on, the system also describes the *artifacts* or tools the subjects use to achieve their objects. Furthermore, activity theory describes how the subject-artifact-object triad is embedded in a socio-cultural context, described in terms of loose networks of people (or *community),* stabilized procedures imposed on the activity (called *rules in place),* and the formally appointed functional groups involved in carrying out the activity which are produced by and result in a *division of labor.* For more details about activity theory, see for example Frank Blackler, 'Knowledge and the Theory of Organizations: Organizations as Activity Systems and the Reframing of Management Studies', *Journal of Management Studies,* 30.6 (November 1993): pp. 863-884; Yrio Engeström, *Learning by Expanding: An Activity-Theoretical Approach to Developmental Research.* Helsinki: Orienta-Konsultit, 1987; and Yrio Engeström, 'Activity Theory as a Framework for Analyzing and Redesigning Work', *Ergonomics,* 43.7 (2000): pp. 960-974.

20 Øystein D. Fjeldstad, Charles C. Snow, Raymond E. Miles, and Christopher Lettl, 'The Architecture of Collaboration', *Strategic Management Journal,* 33.6 (2012): pp. 734-750.

business that are fundamentally different from traditional textbook approaches. In fact, self-organization in multi-actor communities that build and share resources has been observed before. In a paper from 1990, Nobel Prize winner Elinor Ostrom described how she had studied a large number of self-governed forests, fisheries and water-rights that were called 'common pool resources' (CPRs) or 'commons'.[21] Some of these CPRs were successful at preserving the resource, some of them less so.

From her observations, Ostrom was able to formulate eight design principles that 'account for the success of these institutions in sustaining the CPRs and gaining the compliance of generation after generation of appropriators to the rules in use'. The eight design principles are (1) a clear definition of a CPR, (2) the congruence of rules and local conditions, (3) participation in rule making, (4) in monitoring, (5) in sanctioning, (6) access to conflict resolution mechanisms, (7) rights to organize, and (8) nesting of CPRs in larger systems.[22]

It is interesting to note that open design has indeed been compared to a commons in the sense of an openly accessible resource.[23] Yet Ostrom's design principles rarely have surfaced in the discussion. Studying open design as an activity system rather than purely as a resource reveals self-organization in multi-actor communities that indeed care for a shared resource. The activity systems we find in open design resemble Ostrom's institutions that sustain a common pool resource – a commons – for generation after generation.

Relating this observation back to the questions emerging from the Remodel project, we propose to adopt Ostrom's principles when creating, building and nurturing a community as owner of an open source product development project. If we merely study open design as a (passive) resource, we overlook the fact that it involves a lot of work, intentionality, and self-organization in order to generate and maintain such a resource. For simplicity, our proposal groups them into five, rather than eight, design principles:[24]

1. *Clearly defined boundaries*. Participants who have the rights to draw resources from the project must be clearly defined, as must the boundaries of the project (1). This point most directly corresponds to the suggestions of community-building mentioned earlier.
2. *Congruence between appropriation and provision rules and local conditions*. Rules restricting time, place, technology, or quantity of resource appropriation are related to local conditions and to provision rules requiring labor, material, or money (2). This point highlights what we referred to above as community-centric problems at the core of open design projects.
3. *Governance*. Most participants affected by governing rules can participate in defining and modifying these rules, through monitoring conditions and appropriate behavior,

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21 We use the terms interchangeably.

22 Elinor Ostrom, *Governing the Commons. The Evolution of Institutions for Collective Action.* Cambridge, MA: Cambridge University Press, 1990, p. 90.

23 For a recent study and summary, see Kosmas Gavras, 'Open Source Beyond Software: Re-invent Open Design on the Common's Ground', *Journal of Peer Production,* 13 (April 2019), http://peerproduction.net/issues/issue-13-open/peer-reviewed-papers/open-source-beyond-software/.

24 Within our grouping, we provide the reference to Ostrom's original numbering in brackets.

sanctioning participants who violate rules, and resolving conflicts (3, 4, 5, 6). This point refers to the protocols, processes and infrastructures that enable collaboration.

4. *Relative independence* (minimal recognition of rights to organize). The rights of participants to devise their own institutions are not challenged by external authorities (7).
5. *Nested enterprises.* Appropriation, provision, monitoring, enforcement, conflict resolution and governance activities are organized in multiple layers of nested enterprises in the case of larger systems (8). This is reflected, for example, in the digital maker-entrepreneurs who operated in the context of the larger Thingiverse community.

Conclusion

'What's in it for me?' For open source product design, this is the fundamental question that decides whether or not individuals will contribute to the survival of the project. In this article, we argued that the key to answering this question might not lie in what individuals gain from being part of the community (the resource focused, community-oriented approach), but to what extent individuals as part of the community experience and express ownership of the project (the activity focused, community-based approach).

(Re)applying the theory of the commons, we posit that open source product design projects would benefit from an approach that transcends the level of individual bargaining. Instead, it would aim to design a community around the project that can function as a commons – built with defined boundaries, linked with local conditions, based on appropriate governance principles, supported by relative independence, and able to actively interact with other projects as nested enterprises.

Such an open design project, as Michael Madison suggests, would result in a structured and built commons 'with formal and informal institutional mechanism in place to manage or govern [the] openness [...] distinguished from the unrestricted formal openness which defines the concept of the public domain in intellectual property law'.[25] Ostrom's principles help to guide the activities of creating, building, sharing, and preserving an open design through mass participation. The very notion of open design as a commons offers a valid solution for how to deviate from conventional business models and a market economy.

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Towards an Intersectional Feminist Critical Making

Krystin Gollihue & Abigail Browning

TOWARD AN INTERSECTIONAL FEMINIST CRITICAL MAKING

KRYSTIN GOLLIHUE & ABIGAIL BROWNING

Abigail Browning
Across disciplines, it requires lateral thinking, transduction, relying on others for their expertise. Mirror neurons are a huge part of empathy and they trigger body responses.

Krystin Gollihue
The body literally mirroring another body in order to understand that body[1]

This chapter tells a story, which Sto:lo poet and critic Lee Maracle says is the foundation of theory.[2] Story is how we orient ourselves – to our ideas, our bodies, our relationships, and our selves. Many stories woven together help describe the world in full. Stories help create a truth that validates individual experience, a concept that feminist and scientist Donna Haraway terms feminist objectivity.[3] This chapter is about our experiences with technological literacies, production, mysticism, and the community we build with each other through technological practices. Through a project we call [0U1JA], we argue for more differentiated places of critical, cultural, and emergent making that come from our situated and lived experiences.

[0U1JA] is a digital Ouija board that uses an Arduino microcontroller and accelerometer to transduce movement data into visualizations. Drawn from our own storytelling around the Digital Humanities, critical making, feminism, and technological literacies, the project performs our own relationships to technology as mystical connections. Through the touching and sensing capacities of the Arduino, we trace our early literacy development back to the magic of technology and the ability of storage media – as literary scholar and media theorist Fredrich Kittler argues – to reproduce spirits.[4]

The physical Ouija boards of our youth offered us a space not only to commune with others like us without judgment, but to also control and engage with the unknown. By reconfiguring critical making and technical literacy as a Ouija board – a point of reference specific to our own embodied stories and experiences – we were able to return to a learning environment centered on playful invention, relationship, and happenstance.

Krystin Gollihue
I just felt like I had discovered something entirely new that broke apart everything I had thought about what electronics were I was actually telling a student this - she saw me

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1 Transcript from Google chat between the two authors.
2 Lee Maracle, *Oratory: Coming to Theory*, North Vancouver, BC: Gallerie Publications, 1990.
3 Donna Haraway, 'Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective', *Feminist Studies* 14.3 (1988): pp. 575-599.
4 Friedrich A. Kittler, *Gramophone, Film, Typewriter*, Stanford: Stanford University Press, 1999.

> *working and she mentioned how much she hated computer science in high school. and I said, 'yeah, it's definitely rewired my brain, and it's been really hard, but I feel like I'm a new person now'. It's like seeing your DNA for the very first time, it's always been there, someone's probs seen it before. But you, looking at yourself, it's magic!*
>
> Abigail Browning
> *It's empowering, and is applicable to all fields of study, and exciting to make something and finally feel less helpless about the world around you*

Finding Invention

In December 2015, we began [0U1JA] with a talking-circle dialogue (see our Gchats throughout this chapter) about what drew us to digital scholarship and critical making. The following spring, we met for a brainstorming session using an invention process developed by cybermedia theorist Gregory Ulmer called the *popcycle*, a heuristic that helps a writer identify the 'circulation of signification through the institutions' of Family, Entertainment, School, and Discipline.[5] During the session, we composed multimodal texts that represented our interpretations of these themes. What emerged were shared feelings of disconnectedness within academic spaces – we exchanged stories of the ways infrastructures repeatedly erase more personal ways of communicating and being.



Fig. 1. Greg Brown, two friends divining through the Ouija, 2019.[6]

5 Gregory L. Ulmer, *Heuretics: The Logic of Invention*, Baltimore: John Hopkins University Press, 1994, p. 195.
6 Reprinted with permission of the photographer.

Many of these early meetings were over coffee or food, where we sought tactical solutions to systemic problems that were designed to keep people like us (femmes, artists, neurodiverse) out of academia and out of technoculture. Our conversations sought a different system, one that allowed for genuine and loving interaction between people who were never meant to exist within the academy. We thought back to when we had experienced that kind of community with our mothers, aunts, nanas, grannies, sisters, and friends. Somehow in our development, love and curiosity turned into insecurity, where our relationships to things and each other were recast as frivolous, distracting, and irrelevant to more 'serious' pursuits.

That turn coincided with what we described as 'tracking'. As teenagers, we were encouraged to pursue disciplines like writing, dance, literature, and art as opposed to electronics, mathematics, science, and experimentation. As adult scholars, we have difficulty reconciling our curiosity in the masculine-dominated discipline of media and technology with our formative activities in more feminized fields. Outside of a basic technical proficiency, we had not been explicitly asked to learn about the inner workings of the computers around us. But as graduate students, we sought out opportunities to work with code and circuitry as integral elements of our identities.

Learning the circuit board and teaching ourselves the code to create [0U1JA] entailed one kind of invention process, but our popcycle and follow-up dialogues was another. Combined, they prompted reflection on the ways that our activities, whether disciplined or relational, were *implicitly* technological. As technical communication scholar Angela Haas writes, our practices were *digital*, meaning *of the fingers.*[7] For example, we followed recipes, learning how to transduce materials into consumable items. We followed coded patterns to knit and crochet blankets. We replicated technical processes of photography and film processing. We even wrote poems that followed our own algorithms. These were the mechanics we knew. While we honed our identity as makers through these conversations, we still had little reference for our identities as *electronic* creators. Outside of socially-acceptable, necessity-born forays into HTML and blogging, code was unfamiliar. The inner workings of a computational machine were unfamiliar, but we could begin with a technology that we knew.

Haraway writes that as feminists, we must 'learn in our bodies, endowed with primate color and stereoscopic vision, how to attach the objective to our theoretical and political scanners in order to name where we are and are not'.[8] Our experiences in academic contexts had erased feeling as a mode of meaning-making, rendering us *not* present in discussions of early technical literacies. However, our attention to our embodied histories showed us how to intervene into traditional ways of learning technology: we needed to create our own forms of procedural literacy, intertwined with story, experience, and feeling.

In discussing Ulmer's 'Entertainment' cycle, we remembered a tool that each of us had intimate and joyful experiences with – the Ouija board, a mystical game that we played at slumber parties as young people. As an inventional tool, the Ouija board is a map created for open-ended

7 Angela M. Haas, 'Wampum as Hypertext: An American Indian Intellectual Tradition of Multimedia Theory and Practice', *Studies in American Indian Literatures* 19, no. 4 (2007): pp. 77-100.

8 Haraway, 'Situated Knowledges', p. 582.

questions that interfaces with the body. To speak with Donna Haraway's Cyborg Manifesto, the game itself demonstrates how 'bodies are maps of power and identity'.[9] Participation requires an openness to the unknown, to taking joy (or sometimes fear) in what we cannot understand. The Ouija board was a perfect analog to what we wanted from learning new media technologies: a place for questions and stories, a place for curiosity, vulnerability, and play.

Krystin Gollihue
it's so good talking to you about these things.

Abigail Browning
hugs!!! this is lovely! xoxox

Krystin Gollihue
I'm glad we're doing this together!! <3

Transducing [0U1JA]

To create [0U1JA], we used a basic Arduino board that is outfitted for several digital and analog inputs and outputs. The input sensor was an accelerometer breakout board, and the output was a compiled sketch using Processing visuals. The accelerometer measures rates of acceleration, both static forces like gravity on a stationary object and dynamic forces like movement, vibration, or shock. Because an accelerometer has both static and dynamic properties, the sensory possibilities for [0U1JA] focused mostly on rates of velocity and g-force produced from two sets of hands upon the planchette. We mapped these phenomena to points along a spectrum, from the users touching the accelerometer but not moving it, all the way to an extremely dynamic movement of the apparatus quickly across x and y coordinates.

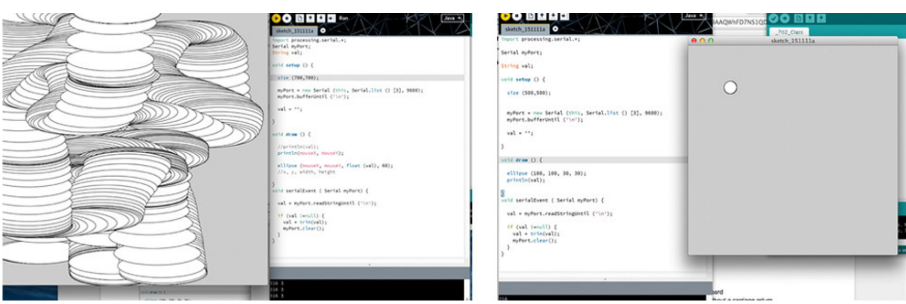


Fig. 2 and 3. Abigail Browning and Krystin Gollihue. Our early Processing sketches: code adjacent to playful ellipses as possible visual reincarnations of the Ouija's planchette 'eye', 2017.

9 Donna Haraway, 'A Cyborg Manifesto: Science, Technology, and Socialist Feminism in the Late Twentieth Century', in David Bell and Barbara M. Kennedy (eds) *The Cybercultures Reader,* London and New York: Psychology Press, 2000, p. 315.

Once we were able to gather data from the accelerometer, we developed a Processing sketch that would use acceleration to create visual phenomena on a screen. While we used this program development to learn the Processing language, we also wanted to embody the technocultural practices of a traditional Ouija board. Through procedural learning, we hoped to accomplish three things: 1) depict a space for play, uncertainty, and mysticism; 2) tap into the ways bodies interact with mystical 'seeing' objects like the Ouija board; 3) create a space that mirrored the kinds of community accessible to us in our youth and outside of technological and educational institutions.

Paranormal Perception

Due to the accelerometer's extreme sensitivity, we could not 'learn' or 'predict' the movement of the digital Ouija or the exact relationship between input and output. This uncertainty mirrors the uncertainty of paranormal activity that helped to create connections between Ouija users; is it extrasensory perception, or is the other user creating some phenomenon, or is it truly a spirit? We reveled in the idea of not-knowing or even the potential of *never*-knowing (antithetical to academia). While these questions haunted us, we enjoyed existing in them, just as we had enjoyed the thrill of the mystical Ouija board as young people.

In magical circumstances, we are both connected (to the unknown and to other communers) and disconnected (from our own bodies). Critical theorist Christopher Peterson writes that our 'self-presence is predicated...on the nonpresence of others',[10] but Ouija boards indicate to us both a presence of other (the other users) and a nonpresence of other (the spectral output). With [0U1JA], we experienced a kind of haunting that drew us together in a sympathetic paranormalism. In 1890, a few years after the invention of the Ouija board, Scottish folklorist and anthropologist James Frazer wrote that 'things act on each other at a distance through a secret sympathy' during paranormal activity.[11] In creating [0U1JA], our bodies were being acted upon through one kind of secret sympathy – our fight-or-flight bodily response to danger – but we also experienced another secret sympathy mediated between the two users of the Arduino. It was a direct analog to the ways the physical Ouija boards of our youth brought us together with each other and with spirits in unidentifiable, mystical, yet emotionally surprising ways.

Accidental Identities and The Body's Knowing

Through coding, we learned how to inscribe embodied feeling into an assemblage of technical loops, how to map shared feeling and create new meaning. These intersections are meaningful, because as queer theorist Jasbir Puar argues, bodies can't be broken down and sedimented by their identities.[12] Ultimately, intersectionality is not a thing, it's a doing: 'identification is a process; identity is an encounter, an event, an accident, in fact. Identities are multicausal,

10 Christopher Peterson, 'Derrida's Ouija Board', *Qui Parle* 17.2 (2009): p. 86.
11 James Frazer, *The Golden Bough*, Hertfordshire: Wordsworth Editions Limited, 1993.
12 Jasbir K. Puar, '"I Would Rather Be a Cyborg Than a Goddess": Becoming-Intersectional in Assemblage Theory', *PhiloSOPHIA* 2, no. 1 (2012): pp. 49-66.

multidirectional, liminal; traces aren't always self-evident'.[13] The process of using the digital Ouija board disassembles and reassembles meaning through and without bodies. [0U1JA] is an opportunity to visualize – not simply theorize – our partial, co-constructing narratives.

Because we understood how the accelerometer worked, we knew that our bodies would create data no matter what. And because postmodern literary critic and media scholar Katherine Hayles stresses that 'characteristic ways of sitting, gesturing, walking, and moving are culturally specific,'[14] we wondered how our embedded cultural knowledges would interact with the output. If we could not control what was occurring on the screen using the digital planchette, what was controlling it? The process forced us to grapple with the way that 'bodies are unstable entities that cannot be seamlessly disaggregated into identity formations'.[15] Did the experience make us feel unsafe or unstable, as one might feel with a haunting? Or did it make us feel curious, wanting more data in order to see what other phenomena might occur?

In creating a project that centered embodied, partial knowledges, mysticism, and technology, we also created a space for *feeling* inside of academia. Notably, historian and cultural scholar Dian Million describes the inclusion of 'emotional knowledges' as an important departure from traditional White Academic historical accounts – this felt theory is one of the important ways for telling the full story of genocide and abuse for First Nations.[16] Further, sociologists Jochen Kleres and Åsa Wettergren identify emotions as a driving part of rational decision making, moreover, that 'one needs to *"feel"* the knowledge in order to be moved to act by it' (emphasis ours).[17] Our work challenges traditional intersections of coding with an emphatic call for the visibility of 'local knowledges',[18] such as feeling, as part of the technical space.

Making Unapologetic Space

Throughout the discussions and technical development of [0U1JA], we sensed the way space was being constructed through the process of invention. Our contradictory selves experienced the desire to participate in the technical culture of making – despite the academic barriers and cultural pressures that aimed to prevent us from doing so. To even undertake this project, we had to ask a professor to teach a separate, directed research course for the two of us (we were lucky that they said yes). Ultimately, we needed to tear away and make a space for learning coding. As Haraway explains, 'the split and contradictory self is the one who can interrogate positionings and be accountable, the one who can construct and join rational conversations and fantastic imaginings that change history'.[19]

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13 Puar, 'Becoming-Intersectional', p. 59.
14 Katherine N. Hayles, 'The Materiality of Informatics', *Configurations* 1, no. 1 (1993): p. 157.
15 Puar, 'Becoming-Intersectional', p. 56.
16 Dian Million, 'Felt Theory: An Indigenous Feminist Approach to Affect and History', *Wicazo Sa Review* 24, no. 2 (2009): pp. 53-76.
17 Jochen Kleres and Åsa Wettergren, 'Fear, Hope, Anger, and Guilt in Climate Activism', *Social Movement Studies* 16, no. 5 (2017): pp. 507-519.
18 Haraway, 'Situated Knowledges', p. 579.
19 Haraway, 'Situated Knowledges', p. 586.

Throughout, we communicated with one another in traditionally 'feminine' ways, whether emotionally through humor or through narrative as we developed code or visualizations. In doing so, the space around us began to reflect the private and extra-institutional spaces we frequented as young people. Feminist scholars Angela McRobbie and Jenny Garber coined the term 'bedroom culture' to describe the places where girlhood as a subculture is cultivated.[20] Marketing researcher Kandy James's 2000 study on teenage girls' bedrooms found that girls overwhelmingly identified this space as one of the few safe, secure, and controllable locations in their lives.[21] While the bedroom is private and controllable, its mirror image is the public – a harmful and unwieldy space and a constant affront to a young girl's identity. This perspective relies on the privilege of having access to a private space where a young girl feels she has power, which we were fortunate to have, coming from white, middle- and working-class families.

Other private spaces exist at the intersections of other identities, however, and shed light on how we might envision critical making as stemming from a safe place for learning. For example, cultural scholar Carmen Kynard and rhetorical theorist Vorris B. Nunley have both written of the private space of *hush harbors* for African American men and women. Nunley defines hush harbors as 'camouflaged locations, hidden sites, and enclosed places' that transform into places for free language, voicing what has gone unsaid, and 'sing[ing] their own songs to their own selves in their own communities.'[22] Nunley uses the examples of the African American church and the Black barber shop, places where African Americans can hide in plain sight and yet make meaning in their own vernaculars. These spaces were explicitly created because enslaved Africans in the United States and their ancestors were kept out of mainstream institutions. In writing of young African American women's hush harbors, Kynard argues for 'enacting and embodying discursive spaces that teach working-class/working poor people alternate gendered and racialized roles in white institutions'.[23] Hush harbors, like bedroom cultures, are private and controllable, a place for a person to be unapologetically themselves in how they think, talk, and make the world. Hush harbors, however, are unique in that they are historically and specifically African American spaces *within* violent institutions.

Bedroom cultures and hush harbors are private cultures that exist within public structures, and might serve as models for the kinds of critical making that makers who have been regulated out of maker culture are already engaging in. What kinds of critical sensing and making of the world happen in the barber shop, at slumber parties, in kitchens, and within religious ceremonies across culture and space? What reference points do they create for critical makers of marginalized and intersectional identities? To imagine [0U1JA], we had to

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20 Angela McRobbie and Jenny Garber, 'Girls and Subcultures', in Stuart Hall and Tony Jefferson (eds) *Resistance through Rituals: Youth Subcultures in Post-War Britain*, 2nd ed., London: Routledge, pp. 209-222.

21 Kandy James, '"I Just Gotta Have My Own Space!": The Bedroom as a Leisure Site for Adolescent Girls', *Journal of Leisure Research* 33, no. 1 (2001): pp. 71-90.

22 Vorris Nunley, 'From the Harbor to Da Academic Hood: Hush Harbors and an African American Rhetorical Tradition' in Elaine B. Richardson and Ronald L. Jackson II (eds) *African American Rhetorics: Interdisciplinary Perspectives*, Carbondale, IL: Southern Illinois University Press, 2004, p. 223.

23 Carmen Kynard, 'From Candy Girls to Cyber Sista-Cipher: Narrating Black Females' Color-Consciousness and Counterstories in and out of School', *Harvard Educational Review* 80, no. 1 (2010): p. 33.

reflect on its intimate creation of space between the two of us as users. In order to create a *digital* Ouija board, we had to imagine a *traditional* one, engaging discourses and materials that had created connection between us as young girls and femmes outside of educational and technological institutions; these practices are central to our meaning-making, though they existed outside of the boundaries of electronic making. These opportunities for safe, secure making practices revealed the tensions between intimate, domestic, and hidden acts of making and the educational publics that had judged our ways of knowing and being in the world as unwelcome.

Abigail Browning
*yeah exactly un/mediated spaces or un*mediated*

Krystin Gollihue
*I like un*mediated :D*

Toward Intersectional Feminist Critical Making

Throughout the development of [0U1JA], we reflected on what about this project was particularly 'feminist' or 'intersectional', not simply in content or message, but in method. While our own identities cannot speak directly to the intersections of race, [0U1JA] allowed us to imagine a critical making practice where makers could place their own cultural practices within the frame of technical knowledge, despite those practices being deemed extra-institutional, distracting, and unwelcome. An intersectional feminist critical making requires us to welcome those kind of aberrations; procedural literacy in making involves those stories, tangents, and personal reference points that aren't seemingly technical or serious. Writing studies scholar Sarah Arroyo asserts that new media give us new opportunities in 'welcoming the disruptions instead of systematically excluding them'.[24] Marginalized makers are themselves disruptions to institutional environments, shedding light on the ways cultural, emotional, and embodied practices are systematically erased. But our material practices – the ways we create in private, hidden, and nonlinear ways – help recontextualize what matters in critical making.

Implicit in this discussion of procedure and distraction is what counts in the places we make with technology. What counts as knowledge? What counts as technical literacy and technology? What counts as making? For us, an intersectional feminist critical making must reside in what happens at the margins: play, feeling, space, relationships, and the unknown. This requires attention to embodied narratives: what makers experience outside of institutions, the pressures they exist within, the places they are kept out of, and the practices they find familiar and safe. When we create spaces and contexts for critical making, we must be asking ourselves what we are relegating to the margins and what we are centering. We must create opportunities for more time to linger in experience, to

24 Sarah Arroyo, *Participatory Composition: Video Culture, Writing, and Electracy*, Carbondale, IL: Southern Illinois University Press, 2013, p. 60.

play, to focus on the personal and relational parts of our scholarship and creations, and to forge relationships with others like and unlike us. An intersectional feminist critical making praxis calls for us to create from our bodies, to invent in and with them, and to value that practice as knowing.

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Hacking & Designing: Paradoxes of Collaborative Practice

Anja Groten

HACKING & DESIGNING: PARADOXES OF COLLABORATIVE PRACTICE

ANJA GROTEN

The concept of hacking is not discipline-specific; it is not exclusive to the field of computer programming. For this reason, designers and design educators freely use hacking terminology to describe design.[1] The hacking approach implies a 'critical and playful design practice inspired by historical and current hacker, net art, "do-it-yourself" and "re-mix" cultures and practices'.[2] However, I will argue here that this appropriation of hacking terminology by designers misses out on addressing the sociality inherent in hacking practices. Hacking seems enticing, holding out appealing modes of self-determined making. Yet if we 'critical' designers flirt with these modes, we also need to interrogate why hacking communities are known to be inaccessible to 'women, minorities, or other underrepresented groups'.[3] We need to move beyond fetishizing the hacker mode of production, and instead investigate the convoluted social construct of hacking – including its frictions and dilemmas.

The Practice of Hackers & Designers

As a designer, educator and member of the Amsterdam-based workshop initiative Hackers & Designers (H&D), I have long identified with modes of hacking. One concrete example is 'Levels of Autonomy', a workshop centered on self-driving cars in which participants hack remote controlled toy cars.[4] By repurposing the switches on the controls, and applying sensors and micro-controllers, the toys slowly transform into miniature self-driving cars, which can follow a line and stop in front of obstacles. The making process is accompanied by discussions about the sociotechnical implications of the self-driving car. Modes of hacking in the context of the self-driving car workshop describe foremost a mentality – a defiant yet playful attitude to making.

H&D is not the only initiative advocating hacking approaches within art and design contexts. Hacking events fill the agendas of many cultural organizations. For these organizations, hacking is a way to emancipate users of technology from being *passive consumers* to becoming *critical makers.* However, the implications of hacking remain unexamined in initiatives such as *Hack the Body*,[5] *Hacking the News*,[6] or *Hack Your Style.*[7]

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1 WdKA Minor Programmes / Presentations 2018, https://www.wdka.nl/news-events/minor-programmes-presentations-2018.

2 Anne Galloway, Jonah Brucker-Cohen, Lalya Gaye, Elizabeth Goodman and Dan Hill, 'Design for hackability', *Designing Interactive Systems: Processes, Practices, Methods, and Techniques*, (2004): 363-366. Also available from: https://www.researchgate.net/publication/221441240_Design_for_hackability.

3 Lint Finley, 'Linus Creator is Sorry. But Will He Change?', 17 August 2018, https://www.wired.com/story/linuxs-creator-is-sorry-but-will-he-change/.

4 Hackers & Designers, https://hackersanddesigners.nl/s/Projects/p/Levels_of_Autonomy.

5 'Hack The Body', *Baltan Laboratories*, http://hackthebody.nl/.

6 'Hacking the News', *MU*, http://www.mu.nl/en/about/agenda/hacking-the-news.

7 'Hack je stijl!', *Het Nieuwe Instituut*, https://hetnieuweinstituut.nl/hack-je-stijl.

The experiment below posits a conversation between two stereotypes: a hacker (H) and a designer (D). This imaginary discussion expresses my suspicions toward designerly approaches to hacking, and questions whether hacking could become a distinguishable and critical form of designing.[8] The dialogue is based on conversations and personal experiences engaging with hackers,[9] designers and artists. It also draws from anthropological studies of hacking culture and more recent debates on the hostility of hacking environments.

D: In recent years, designers and design educators have started using hacking jargon to rethink design methods and come up with new approaches for design. H, you are a real hacker. Do you see problems in the appropriation of hacking jargon by designers?

H: I doubt designers actually understand what hacking means. Hacking is not a method you can first learn and then apply. Neither can you conceptualize hacking by means of design. Designers need to learn how to write, read, and fix code. They need to get literate before they can call themselves hackers.

D: So you think designers only look at those aspects of hacking they can relate to, but ignore the others? I would actually argue that designers' ways of making are not alien to the practice of hacking. Most designers I know use hacking terminology as a way to describe a specific approach to making. Isn't hacking a way of making?

H: Hacking might be a way of making. But it could be also a way of breaking. A hacker – just like a designer I imagine – finds pleasure in creating. But hacking is more of an attitude than a practice.

D: I can see that. Actually I think it is the attitude you are mentioning that is particularly interesting to us designers. Hackers seem to put forward a self-determined and sometimes unruly attitude to making.[10] You can apply hacking modes to a huge variety of circumstances. That's why designers freely use hacking terms to describe what they do. Hacking is not exclusive to one discipline, is it?

H: Hacking might be an attitude towards making. But this attitude is tightly connected to the practice of writing software, debugging, running and maintaining systems, which is – and this is important to acknowledge – continuously frustrating! Hackers are exposed to things *not working*. The hacking attitude that is so interesting for you designers is a direct result of encountering resistance, over and over again. Hackers have developed a tremendous tolerance to frustration because we are constantly fighting code. It is the thin line between frustration and pleasure that is important to understand when describing a hacker's mode of production.

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8 For instance, H&D claims to engage participants in developing critical standpoints through modes of hacking – by getting your hands dirty rather than a distanced critique of analyzing and reflecting on technological products.

9 Referring to hackers I describe mostly – but not exclusively – software developers within my proximity who use and contribute to Free/Libre Open Source Software (F/OSS). While such hackers are not explicitly political, they are idealistic about the code they write. They gather and build communities mostly on the basis of skills rather than ideologies.

10 Graham, Paul. 'The Word Hacker', April 2004, http://www.paulgraham.com/gba.html.

D: That hacking mode you are describing is in fact something I recognize in my own practice. As designers, we learned how to work skilfully and smoothly. We do things spontaneously, 'without thinking' so to speak, drawing on tacit knowledge. There are instances during design processes when this tacit knowledge is disrupted.[11] The material or tool can behave differently than expected. That disruption might be pleasantly surprising, or unpleasantly disturbing – frustrating as you said before.

H: There is what is called *deep hack mode*,[12] which is a bit different than what you describe. Entering a deep hack mode is the ability to enter a state of high concentration. In any case, I object to the idea of chance within hacking. Code is either working or not working. If it's not working it means someone made a mistake that needs to be fixed. I might fix the code in a straightforward way, or I fix it in ways nobody has thought of yet. The latter is called a *good hack*.

D: So the fact that nobody has thought about it yet qualifies a line of code to be a good hack? Is it important to you that your code is recognized by others as a unique piece of work? Is there a social pressure involved in hacking?

H: Hacking, as I experience it, is definitely a social activity. Although we might not often meet in person, there is a general understanding amongst hackers that the technologies we are building and using are created by a vast amount of other people. I wouldn't want to call this social pressure. I want to come up with good hacks in order to contribute to projects greater than what I could produce on my own. By the way, documentation is crucial for code to be reusable by others. I always make sure my code is clean and beautiful before I publish it. If hackers like my code it means what I made is effective. It's a compliment when someone uses my code.

D: Interesting. So coding is a social practice, but also an aesthetic one?

H: Certainly.

D: So there might be another commonality between Hackers and Designers. Hackers too like to simplify and visually communicate through the work they produce.

H: I get it. You are trying to find out if the hacking approach can be useful across disciplines. You want to gain hacking insights in order to obtain a better understanding of your own discipline. You know, I don't even care about your so-called design methods. All I want to make clear is that there is more to hacking that needs to be considered. Hacking is not a method. If you dig a little deeper you will come across complex forms of interactions, which shape what hackers produce and how they produce it. You cannot learn hacking like you would learn a skill, a subject, or a method. Hacking derives from and contributes to an ecology. You need to be embedded in the ecology in order to understand its workings. You designers tend to glorify hacking and forget about a whole lot of dynamics that are at play in hacking culture. Hackers cannot be described

11 Donald Schön, *Educating the Reflective Practitioner,* San Francisco, London: Jossey-Bass Publishers, 1988.
12 Jargonfile, http://catb.org/jargon/html/D/deep-hack-mode.html.

as a homogeneous group. There are many tensions and contradictions within hacker communities. Some hackers make money, some are activists, some are criminals – yet they might all work together on the same project.

D: I'm curious; the sociality you are addressing seems to relate to what people call the 'hacker ethic' – a foundation for dealing critically and creatively with technology.[13][14] But what you are also saying is, while hackers share a common ethical ground and work together, they also disagree and fight?

H: Yes, but they don't fight about politics. They fight about code and its principles and I can assure you, they don't care about politeness.

D: What would you say are the consequences of the diverse intentions and motivations inherent in hacking practices? Do you think that the plurality of different personalities and beliefs enables a productive form of friction?

H: Well that depends on what you consider to be productive, and what is included and excluded when you refer to 'different personalities'. Friction might actually be a core characteristic of the hacker mode of production. But if you ask under which conditions these practices produce code, you might find that these practices are productive only for those who are resilient enough to expose themselves to direct confrontation. To some people, hacking environments can come across as insensitive, judgmental, and hostile. There are people who are either not used to such environments or who are not willing to work within them. By only looking only at the bright side of hacking culture, there is a danger of overlooking certain characteristics of a strand of makers who – besides their many positive achievements – have also produced alt-right deviations and non-inclusive spaces. Some say that these hostile environments make non-male and non-white makers, or makers above the age of 30, feel unwelcome.[15] 'There are many examples that demonstrate the hostility women face while working in online hacking environments. In a hate-mail entitled "Death to Women's Rights" on the [Debian-women] mailing list, a man expressed how much he despised women because they complain there is no[t] enough women in male-dominated but successful fields'.[16]

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13 Paraphrasing Frank Rieger's quote 'Die Hackerethik ist die Grundlage für den Umgang mit den diversen ethischen Problemen, die sich beim schöpferisch-kritischen Umgang mit Technologie (auch "hacking" genannt) stellen'. in Frank Rieger, 'Hackerethik – eine Einführung Verantwortung und Ethik beim schöpferisch-kritischen Umgang mit Technologie', *Chaos Computer Congress*, 27 December 2018, https://media.ccc.de/v/35c3-10011-hackerethik_-_eine_einfuhrung/.

14 The term hacker ethic, when used by hacker communities such as the Chaos Computer Club, refers back to Steven Levy's notion of hacker ethic as 'an ethic seldom codified, but embodied in the behavior of hackers themselves'. Levy, Steven. *Hackers. Heroes of the Computer Revolution*, London: Penguin Books, 1994 (1984), pp. x.

15 Ali Spivak, 'Inclusion Includes You Let's talk about How Inclusion Benefits All of Us', Mozilla devroom, *Fosdem 2019,* 2 February 2019*,* https://fosdem.org/2019/schedule/event/inclusion_includes_you/.

16 Paraphrasing from: Yuwei Lin, 'A Techno-Feminist Perspective on the Free/Libre Open Source Software Development' in: *Gender and IT Encyclopedia*, Idea Groups, 2006.

D: Right. I also heard about the recent controversy with the aggressive rhetoric used by Linux kernel creator Linus Torvalds.[17]

H: Torvalds is notorious for his political incorrectness.

D: He's been called out on verbal abuse and personal intimidation in his online communication.[18]

H: After being publicly confronted by a female Linux developer, Torvalds was forced to revise his 'code of conflict',[19] which promoted 'no-filter feedback and bluntness as the natural and more successful state of open source software development'.[20]

D: Apart from the ethical dimensions, hacking culture encompasses peculiar pedagogical facets. Hackers promote open access to information, unlimited possibilities for exchanging knowledge, and the right to learn. On the other hand, confrontational rhetorics – I'm thinking for instance of 'RTFM' (read the fucking manual) – mark another pedagogical dimension of hacker culture: the importance of technical self-cultivation.

H: The confrontational nature of hackers' ways of communicating with each other is essential to their modes of co-producing. Only by practicing a radical transparency and directness are hackers able to express – through their work – their positions and along with it, their partiality and omissions. They sustain space for others to confront them.

D: So would you say that the ability to work collectivity is so crucial that hackers will open up the work they produce? How is this openness put into practice?

H: The constant state of exposure – and along with it, a sustained vulnerability – is enabled only through constant and meticulous practices of documentation. Far from covering up our bugs, we openly acknowledge and even explain them. We don't hide problems.[21] The virtue of transparency is that it makes actions accountable. The community is built upon

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17 Jon Brodkin, 'Linus Torvalds Defends his Right to Shame Linux Kernel Developers. "My Culture is Cursing": Linux Kernel World is a Hostile Place – By Design', *Ars Technica,* 16 June 2013, https://arstechnica.com/information-technology/2013/07/linus-torvalds-defends-his-right-to-shame-linux-kernel-developers/.

18 Linus Torvalds, 'Linux 4.19-rc4 released, an apology, and a maintainership note', posting to the Linux Kernel Mailing List, 16 September 2018, https://lkml.org/lkml/2018/9/16/167/.

19 Steven Vaughan-Nichols, 'Revised Linux Code of Conduct is now officially part of Linux. With the release of the Linux kernel 4.19 came not just new features and bug fixes, but the new Linux Code of Conduct as well', ZDNet, 22 October 2018, https://www.zdnet.com/article/revised-linux-code-of-conduct-is-now-officially-part-of-linux/.

20 Nick Statt, 'Linus Torvalds returns to Linux development with new code of conduct in place: Torvalds took a self-imposed break to rethink his controversial treatment of others', The Verge, 22 October 2018, https://www.theverge.com/2018/10/22/18011854/linus-torvalds-linux-kernel-development-return-code-of-conduct/.

21 See also: Debian-Gesellschaftsvertrag: 3. 'Wir werden Probleme nicht verbergen Wir werden unsere Fehlerdatenbank für alle Zeiten öffentlich betreiben. Fehlermeldungen, die von Personen online abgeschickt werden, werden unverzüglich für andere sichtbar', Debian.org, https://www.debian.org/social_contract.

social dynamics that are informed by frictional interaction. Those frictions mark hacker culture. Through constant exposure to the possibility of potential disagreement and dispute, hackers are constantly 'making and remaking themselves'.[22]

D: I think I get your point. We can't talk about hacking without also talking about community, infrastructures, and inevitable cultural codes. The paradoxes you described bring about important frictions within hacker communities, and are crucial to an understanding of the hacker way of working. These frictions don't seem incidental. No, they're actively made, widely publicized, and openly negotiated. Instead of idealizing a hacker archetype, designers could learn more from the dilemmas of this maker culture. This, in turn, might help them reflect on the missed opportunities and weak points of their own practices. Designers should disseminate their work in ways that force still-vulnerable processes to be exposed and possibly contested. If we stop clutching so tightly to the paradigm of making 'convincing work', and instead embrace the limits of our practices, designers could create our own ecology of frictions.

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22 Gabriella Coleman, *Coding Freedom. The Ethics and Aesthetics of Hacking*, New Jersey, Oxfordshire: Princeton University Press, 1973, pp. 27.

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Hacking the Hustle: Sex Work, Networks, & Social Reproduction Under FOSTA-SESTA

Grace Van Ness

HACKING THE HUSTLE: SEX WORK, NETWORKS, & SOCIAL REPRODUCTION UNDER FOSTA-SESTA

GRACE VAN NESS

February 27th, 2018. FOSTA-SESTA passes in the United States House of Representatives, 388 to 25.

March 21st, 2018. FOSTA-SESTA passes in the Senate, 97 to 2. Reddit bans sex work-related subreddits.

March 22nd, 2018. I purge four years worth of emails and posts. Worry. Switch from Gmail to ProtonMail. Worry. Reconsider purging my online accounts. Am I giving in to fear? Am I falling into a trap? I scroll frantically through Twitter. What is everyone else doing? I open a new tab, scroll frantically through the Electronic Frontier Foundation's *Surveillance Self-Defense* guide. I switch tabs. Scroll. Switch tabs. Worry.

March 23rd, 2018. Craigslist takes down its Personals section.

March 25th, 2018. Standing on the platform, waiting for the C train back to Brooklyn. I shove a pair of electric blue heels deeper into my bag and press the phone tight against my ear: 'Do what feels right for you. Do what feels possible for you. Do what feels safest while also being cognizant'. The voice comes in faintly through the rustling and clicking of linked cell phones on a dial-in meeting of hundreds of other sex workers. 'You are making decisions that are incredibly hard, and only you can know what is right for you'.

March 27th, 2018. Microsoft bans nudity on Skype.

April 3rd, 2018. NSFW files in my Google Drive disappear.

April 6th, 2018. Backpage.com is seized by United States federal authorities.

April 11th, 2018. President Trump signs FOSTA-SESTA into law.

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Scrolling through the journaled notes on my phone almost a year after FOSTA-SESTA became law, I'm amazed at how far we've come for how little we've gained. As a porn performer, I revere the hard-fought battles for community, health, representation, and safety waged by the fierce sex worker activists, advocates, and organizations in constant defense of our rights. In a position of great privilege in the industry, the work that I do, while stigmatized, is not criminalized in the way that other forms of sex work still are in the United States. Determined by these conditions – as well as the simultaneous and intersecting influences of race, class, gender, and sexual orientation[1] – the impact of social and legislative change is experienced by sex workers to multiple, varying degrees. For many, and in a very literal way, both their *current* and *continued* existence is at stake.

Increasingly, this war is waged in the cybersphere. Already practiced at appropriating and repurposing as a means of survival, sex workers and those who trade sex within this new dynamic and digital network continue to *hack* their means of social reproduction.[2] Connected through praxis and ethos to the intersectional feminist hacker and makerspace, but lacking its resources, it is through a mutually beneficial *crossing* and *knotting* of networks that these movements can both independently and collectively grow, adapt, and, in so doing, *resist*.

As an exploratory case study in the collaborative potential of sex worker and intersectional feminist hacker and maker communities, this piece begins with a brief overview of FOSTA-SESTA and the way in which it has immediately and drastically limited the capacity for the social reproduction of workers in the sex industry. As context, the next section examines the history of the sex workers' rights movement, establishing a rich, sex worker-led tradition of reclaiming and repurposing the means of social reproduction as a form of resistance. This tradition will then be traced and linked to current on- and offline technological appropriation by sex workers in direct response to the adoption of FOSTA-SESTA. Drawing a comparison here to the practice and intent of *hacking* within the intersectional feminist hacker and/or maker space (for brevity: IFH/MS), the piece concludes with an inspired nod to Hacking//Hustling, a 2018 tech-focused, sex worker-led panel, workshop, and art show dedicated to knowledge exchange over a post-FOSTA-SESTA internet.

FOSTA-SESTA and its Impact

Dubbed 'Frankenstein's Monster of a bill' by the Electronic Frontier Foundation,[3] the Fight Online Sex Trafficking Act (FOSTA) and the Stop Enabling Sex Traffickers Act (SESTA) were originally conceived as two separate bills intended to weaken the protection of Section 230 of the 1996 Communications Decency Act, which holds that: 'No provider or user of an interactive computer service shall be treated as the publisher or speaker of any information provided

1 Combahee River Collective, *The Combahee River Collective Statement: Black Feminist Organizing in the Seventies and Eighties*, vol. 1, Freedom Organizing Series (Albany, NY: Kitchen Table, 1986).

2 This concept of and call for a reclamation of the means of reproduction – and, importantly, *social* reproduction – as a necessary component of successful and scalable resistance is based in feminist Marxist thought. In this understanding – advanced by Silvia Federici and others – the 'means of reproduction' include not only physical necessities like food and shelter, but emotional and intellectual care, and emphasize the necessary *collectivity* of this reproductive process.

3 Elliot Harmon, 'FOSTA Would Be a Disaster for Online Communities', *Electronic Frontier Foundation*, February 23, 2018, https://www.eff.org/deeplinks/2018/02/fosta-would-be-disaster-online-communities.

by another information content provider'.[4] The bill seeks to clarify that this section of the Decency Act, among other specifications, 'was never intended to provide legal protection to websites that unlawfully promote and facilitate prostitution and websites that facilitate traffickers in advertising the sale of unlawful sex acts with sex trafficking victims'.[5] The result, essentially, is that online websites and platforms can now be held liable for user-generated posts deemed unlawful – whether the page owner has knowledge of the content or not. Importantly, this mandate is also applied *retroactively*, such that *all* posts on a site – past and future – are subject to prosecution.

At risk of seizure, lawsuit, hefty fines, and possible jail time, websites acted swiftly and without warning to protect themselves from the broad reach of the new bill – many preemptively censoring themselves *weeks* before FOSTA-SESTA was signed into law. While purportedly intended to target abuse by sex traffickers, FOSTA-SESTA's notably vague language around what constitutes 'promotion' or 'facilitation' or even 'prostitution' has led many platforms – Craigslist and Reddit, quite visibly – to eliminate entire categories of content rather than undertake the daunting, expensive, and imperfect task of sifting through and removing only those posts in violation of the new federal guidelines.[6]

Both before and during this reactionary wave, websites used specifically by sex workers to advertise their services online at no- or low-cost – notably Backpage, as well as Nightshift and CityVibe, among others – were shut down or changed their Terms of Service to prohibit posts containing adult content. In the process, forums and platforms used by providers to safely screen and verify clients, document violence and harassment, provide safety tips, and reference peer-generated 'bad date lists' disappeared, resulting in the loss of an essential resource and years of archived, life-saving content.[7]

Many of the advertising sites still in operation are inaccessibly expensive, presenting a prohibitive barrier to entry for many providers and endangering those already at disproportionate risk of violence and arrest: low-income sex workers, sex workers of color, disabled sex workers, migrant sex workers, and trans sex workers.[8] As such, while some providers can pay higher advertising costs and cater to the wealthier clients on these platforms, more precarious workers are forced to lower their rates and compromise their safety by seeking clients *offline*.

4 'Section 230 of the Communications Decency Act', *Electronic Frontier Foundation*, https://www.eff.org/issues/cda230.

5 'Public Law 115-164', *Congress.Gov.* April 11, 2018, https://www.congress.gov/115/plaws/publ164/PLAW-115publ164.pdf.

6 Tina Horn, 'How a New Senate Bill Will Screw Over Sex Workers', *Rolling Stone*, June 25, 2018, https://www.rollingstone.com/politics/politics-features/how-a-new-senate-bill-will-screw-over-sex-workers-205311/.

7 Kitty Stryker, '6 Sex Workers Explain How Sharing Client Lists Saves Lives', *Vice,* April 2, 2018, https://www.vice.com/en_us/article/ne975m/sesta-fosta-sex-workers-sharing-client-lists-saves-lives.

8 Melissa Gira Grant, 'Fosta Backers to Sex Workers: Your Work Can Never Be Safe', *The Appeal*, April 24, 2018, https://theappeal.org/fosta-backers-to-sex-workers-your-work-can-never-be-safe-5a67582e04f3/.

As Melissa, a Phoenix-based escort, makes clear:

> It's forcing me to go back to the streets, walking up and down trying to find clients. Now I not only have to deal with the police, but now I'm forced to deal with tricks that know this bill is in effect, and trust me, they are taking full advantage of it by being more aggressive. And unlike being in the safety of my room, I'm in their car, I don't have the option to leave or kick them out.[9]

Compounding these effects are the prohibitions FOSTA-SESTA places on communication between sex workers themselves. Instagram and Twitter – where sex workers gather, connect, and spread news – now hides posts under certain organizing hashtags like #stripper,[10] and frequently 'shadowbans',[11] suspends, or deletes user profiles deemed in violation of site policy.[12] While it should be enough that sex workers deserve to have a social media profile like anybody else, these discriminatory measures constitute a denial of access to knowledge and community. As explained by performer and author Jiz Lee in an interview with Tits and Sass:

> Our best source of support is one another and at the moment that's done most effectively through social media. The more we're able to provide one another with information, to spread resources, give warnings, share recommendations, come together for emergency funding support, or organize political actions, the safer and more empowered we can be.

Relatively brief, this overview merely scratches the surface of FOSTA-SESTA's impact on the business and lives of sex workers, as well as its exacerbatory interaction with existing anti-sex worker structures.[13] By restricting work opportunities through the elimination of low-cost advertising, barring access to safety tools and online client screening processes, and preventing sex workers from communicating with each other online, this bill limits the already limited extent to which sex workers can freely work, live, connect, and organize – the essential components of social reproduction and, thus, effective and sustainable resistance.

Though a daunting reality, instructive precedence and guidance can be found within the sex worker community itself.

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9 Emily McCombs, '"This Bill Is Killing Us": 9 Sex Workers On Their Lives In The Wake Of FOSTA', *Huffington Post*, May 17, 2018, https://www.huffingtonpost.com/entry/sex-workers-sesta-fosta_us_5ad0d7d0e4b0edca2cb964d9.

10 Reese Piper, 'How Censoring Strippers Affects All Women', *Motherboard*, May 31, 2018, https://motherboard.vice.com/en_us/article/nek3gg/instagram-censoring-stripper-hashtags-reese-piper.

11 'Shadowbanning' is the practice by social media platforms of blocking or censoring a user or their posts, preventing their content from being seen by others without notifying the user that they have been blocked.

12 Juniper Fitzgerald and Jessie Sage, 'Shadowbans: Secret Policies Depriving Sex Workers of Income and Community', *Tits and Sass*, June 12, 2019, http://titsandsass.com/shadowbans-secret-policies-depriving-sex-workers-of-income-and-community/.

13 Many have generated and maintain more comprehensive lists of legal discriminations against sex workers, including this public Google doc turned Craigslist-esque webpage compiled post-SESTA by Ashley Lake and Liara Roux (with contributions from many others): https://liaraslist.org/.

History of the Sex Workers' Rights Movement

As begins Melinda Chateauvert's *Sex Workers Unite: A History of the Movement from Stonewall to SlutWalk*, 'Sex workers are fighters' and 'have been fighting for their right to work, for respect and justice, for a very long time'.[14] Though sex workers have engaged in activism for decades, Margo St. James is said to have founded the first American sex workers group in 1973, which adapted and applied feminist consciousness-raising methods in 'rap sessions' and 'whore conventions'.[15] Originally conceived as a safe space for sex workers to swap information, COYOTE (Call Off Your Old Tired Ethics) soon expanded to include a bail fund and peer-edited newspaper, provide legal assistance to workers, and collectively organize against the racism and sexism of the criminal justice system.

After the AIDS epidemic broke out, and amid mass media campaigns framing HIV as a 'punishment for their [hookers'] promiscuity',[16] members of COYOTE formed CAL-PEP (California Prostitutes Education Program) in order to generate funding for HIV research, provide counseling, and support sex worker-led education for 'prostitutes and their sexual partners'. This work led to CAL-PEP's publication of the revolutionary and life-saving text, *Prostitutes Prevent AIDS: A Manual for Health Education,* in 1988.[17]

Since COYOTE's inception, numerous and varied sex workers' rights organizations, advocacy and community groups, and service providers have been established in a similar spirit.

There is the San Francisco-based St. James Infirmary, which provides 'free, compassionate, and non-judgmental healthcare and social services for Sex Workers',[18]as well as The Red Umbrella Project, which focuses on rights advocacy through sex worker-led storytelling and media activism.[19]

Centering its work on the criminal justice system, SWOP Behind Bars 'provides incarcerated sex workers with resources to create community links from the inside out' through the implementation of a book donation and penpal program, the distribution of college scholarships, the creation of study guides and newsletters for prisoners, and the Solidarity Mobile Network – a mobile service for sex workers and allies, whose proceeds support formerly incarcerated sex workers.[20]

Supporting transgender sex workers, G.L.I.T.S. holds regular dinner meetings 'where our community comes to mingle and to be referred to secure health services' and housing, with the

14 Melinda Chateauvert, *Sex Workers Unite!: A History of the Movement from Stonewall to Slutwalk*, Boston, MA: Beacon Press, 2015, p. 1.

15 Chateauvert, *Sex Workers Unite!,* p. 60.

16 Chateauvert, *Sex Workers Unite!,* p. 100.

17 Priscilla Alexander, *Prostitutes Prevent AIDS: A Manual for Health Education,* San Francisco, CA: California Prostitutes Education Project, 1988.

18 St. James Infirmary, http://stjamesinfirmary.org/.

19 Red Umbrella Project, https://redumbrellaproject.org/.

20 SWOP Behind Bars, http://swopbehindbars.org/.

long-term goal of creating a 'major housing facility for people of trans experience and trans sex workers'.[21] Red Canary Song, 'the only grassroots Chinese massage parlor worker coalition in the U.S.', supports migrant sex workers through Know-Your-Rights workshops and accessible chat groups.[22] Also based in New York, the Black Sex Workers Collective seeks to create a 'safe space where the unique experiences and needs of Black sex worker voices are validated and responded to with appropriate needs-based resources'.[23]

This selection, of course, represents only a few of the *numerous* individuals and organizations engaged in sex workers' rights activism and advocacy, but the ubiquity of a *by-and-for* philosophy within the movement, as well as an emphasis on (1) the reclamation of health, housing, and legal services tailored to the specific needs of sex workers, (2) the creation of independent media and educational tools, and (3) the formation and preservation of community through peer-engagement, serves to demonstrate the vibrant spirit of autonomous, social reproduction-oriented organizing at the heart of the sex workers' rights movement.

The Sex Worker Response to FOSTA-SESTA

Drawing on the deep activist tradition of the sex workers' rights movement *offline*, once it became clear that FOSTA-SESTA would be signed into law, sex workers were quick to adapt and react to the intensified *online* threat:

1. Out of a desperate need for information, sex workers began meeting in person and on group calls, inviting other sex workers and allies knowledgeable in tech, journalism, and law to educate attendees on the implications of the bill and how to protect oneself.
2. Both online and at these meetings, lists of alternative advertising platforms and screening services – as well as lists of anti-sex work websites[24] – were generated and circulated. These lists often function as public, dynamic, and editable docs where people can post questions, share experiences and news, and offer real-time advice.
3. Surveillance self-defense guides, how-tos on Tor and VPN usage, and step-by-step profile scrubbing strategies developed by and for sex workers[25] – among many other technical education tools – were compiled and shared widely by existing sex worker activist organizations. A long and tedious process, sex workers often met in-person to work through these digital security tasks together.
4. Large groups of sex workers collectively shifted their business accounts to ProtonMail, a Switzerland-based, open source, encrypted email service, and many now use encrypted messaging apps like Wire and Signal to communicate. Some sex workers also began experimenting with Switter, an open source project from Mastodon that describes itself

21 'About Us,' *GLITS*, https://www.glitsinc.org/about.

22 Red Canary Song, http://www.redcanarysong.org/.

23 Black Sex Worker Collective, https://www.blacksexworkercollective.org/.

24 'Platforms Which Discriminate Against Sex Workers', *#SurvivorsAgainstSESTA*, April 16, 2018, https://survivorsagainstsesta.org/platforms-discriminate-against-sex-workers/.

25 Liara Roux, 'Post-SESTA/FOSTA Self-Censoring for Twitter, Reddit, and Other Social Media', *#SurvivorsAgainstSESTA*, March 24, 2018, https://survivorsagainstsesta.org/2018/03/24/post-sesta-fosta-self-censoring-for-twitter-reddit-and-other-social-media/.

as a 'sex-worker friendly social space,'[26] as well as Hubzilla, a decentralized and open source forum-based space whose unique organization enables the 'revolutionary liberation of online identity from individual servers and domains'.[27]

5. Peer-led skillshares and workshops were organized in an effort to help fellow sex workers diversify their income streams, and many offered necessary services to each other for trade, holding free photography sessions or providing healing body work.
6. Groups such as Bay Area Workers Support (BAWS) – which formed in direct response to FOSTA-SESTA – began accepting donations of cash and gift cards to distribute directly to any sex worker that contacts the group with a request for emergency funds.[28]

These early responses to the adoption of FOSTA-SESTA, among many others, represent a *hacking*, a *repurposing* of technologies by sex workers, for sex workers. By adapting alternative communication methods both on- and offline, as well as developing and sharing necessary skills, services, and resources, the sex worker response to this bill represents a reclamation of the means of social reproduction *from* the cybersphere *within* the cybersphere – much like the work of intersectional feminist hackers and makers.

Intersectional Feminism in Hacker/Maker Spaces

Largely in response to the discrimination, harassment, and lack of inclusion experienced by marginalized groups in traditional hackerspaces,[29] intersectional feminist hacker and makerspaces began to emerge worldwide in the early 2000s. Through the creation of the Geek Feminism Wiki (2008) and Blog (2009),[30] as well as AdaCamp – an in-person unconference held semi-bi-annually between 2012 and 2015 'dedicated to increasing women's participation in open technology and culture'[31] – female, queer, and POC hacktivists began to communicate with each other, sharing experiences, ideas, and skills both on and offline.[32] Out of this network sprung Mz* Baltazar's Lab and Miss Desponias (2009), Mothership HackerMoms (2011), and Liberating Ourselves Locally or LOL!, (2012), as well as Seattle Attic, Double Union, Flux (all in 2013) and FemHack (2016), among several others.

Like the traditional hacker or makerspace, each of these typically autonomous and volunteer-run spaces provides supplies, equipment, and collaborative workspace for its members, and many organize workshops or hackathons, as well as hold regular meetings. What's unique about such IFH/MSs is that they are designed specifically to meet the needs and interests of the communities they are *by* and *for*, thereby allowing for a truly revolutionary *reimagining* of

26 'About', *Switter*, https://switter.at/about.
27 'Hubzilla Documentation: About', *Hubzilla*, https://project.hubzilla.org/help/en/about/about#What_is_Hubzilla_.
28 'About', https://bayareaworkerssupport.org/about.
29 Sophie Toupin, 'Feminist Hackerspaces: The Synthesis of Feminist and Hacker Cultures', *The Journal of Peer Production*, no. 5, October 2014, http://peerproduction.net/issues/issue-5-shared-machine-shops/peer-reviewed-articles/feminist-hackerspaces-the-synthesis-of-feminist-and-hacker-cultures/.
30 'Timeline of Geek Feminism', *Geek Feminism Wiki,* http://geekfeminism.wikia.com/wiki/Timeline_of_geek_feminism.
31 'AdaCamp Toolkit', *AdaCamp*, https://adacamp.org/.
32 Toupin, 'Feminist Hackerspaces'.

a 'different concatenation of social forms, knowledge, and technology'.[33] In so doing, IFH/MS members articulate a strategy of hacking not only software and hardware, but their own social reproduction within the cybersphere. Two brief examples of this work in action:

1. Mothership HackerMoms was founded in 2012 by Sho Sho Smith specifically to support mothers like herself who were struggling to embody the constructed 'perfect modern mother'.[34] In its *Failure Club* workshop series, HackerMoms present and discuss in-progress projects, acknowledging failure as an important aspect of achievement and eschewing the productivist tendencies of traditional hacker culture.[35]As Rosner and Fox describe in their work on the Mothership: 'Failure, in this way, became a common cultural resource that members could use in the framework of daily life to manage their social relations and different realms of work. It was through failure that we saw a productive reworking of female agencies'.[36]
2. Founded in 2012, LOL! is a queer and trans POC-led makerspace in Oakland whose mission is one of self-determination and community power.[37] The space aims to be a 'welcoming place for poor women, trans, low income, formerly incarcerated [...] of and for [the] immediate community [...] political education, social justice [...] *freedom from jobs*'.[38] Rather than functioning merely as a 'training ground for work',[39] here LOL! explicitly articulates 'an alternative value system [...] around technology and technical practice, wherein not only *who* participates in technological production is changed, but *why and how* people engage with technology is altered'.[40]

In prioritizing community formation *offline*, as well as hacking and repurposing technologies *online*, the IFH/MS 'can allow us to develop human-machinic assemblages of social reproduction – digital modes of communicating with bodies *and* technologies that enhance the pleasures of being together, that expand autonomy, erode atomization, and challenge capital's ongoing subsumption'.[41]

The Hacker/Maker as a Cross-Network Ally

While both the sex worker and IFH/MS communities are engaged in a similar social reproduction-oriented means of resistance, unlike the sex industry, working in a hacker or makerspace

33 David Hugill and Elise Danielle Thorburn, 'Reactivating the Social Body in the Insurrectionary Times: A Dialogue with Franco "Bifo" Berardi', *Berkeley Planning Journal* 25, no. 1 (2017), p. 213.
34 Daniela K. Rosner and Sarah E. Fox, 'Legacies of Craft and the Centrality of Failure in a Mother-Operated Hackerspace', *New Media & Society* 18, no. 4 (April 4, 2016), doi:10.1177/1461444816629468, 561.
35 Rosner and Fox, 'Legacies of Craft', p. 559.
36 Rosner and Fox, 'Legacies of Craft', pp. 574-75.
37 'About', *Liberating Ourselves Locally*, https://oaklandmakerspace.wordpress.com/about/.
38 Christina Dunbar-Hester, '"Freedom from Jobs" or Learning to Love to Labor?: Diversity Advocacy and Working Imaginaries in Open Technology Projects', *Revista Teknokultura* 13:2 (2016), p. 558.
39 Dunbar-Hester, 'Freedom from Jobs', p. 558.
40 Dunbar-Hester, 'Freedom from Jobs', p. 558.
41 Elise Danielle Thorburn, 'Networked Social Reproduction: Crises in the Integrated Circuit', *Triple C: Communication, Capitalism & Critique* 14:2 (2016), p. 393.

does not usually entail the degree of surveillance, policing, and discrimination faced daily by sex workers. Yet therein lies the importance of cross-network contribution. In providing valuable technical knowledge and resources, as well as allyship, intersectional feminist hackers and makers can do much to support sex workers in the fight against FOSTA-SESTA.

This collaboration may be exercised in finite actionables such as skillshares or the development of an app, but it must also be implemented on a structural level. On the board of the Open Privacy Research Society, Norman Shamas maintains that:

> Technologists need to consider what the implications of their design decisions are and ensure that their marginalized users are protected against laws like FOSTA [...] Surveillance and policing technology are often refined and tested on marginalized communities. By supporting their rights you are also supporting your rights.[42]

Here, clarified, is the *mutual* benefit of resistance to FOSTA-SESTA. The bill, while particularly and immediately dangerous for sex workers, has broad, disastrous implications for all internet users – and particularly those in marginalized groups. In recognition of this threat, FOSTA-SESTA has been challenged by a number of tech activist organizations on the basis that the bill violates the First Amendment.[43] In a February 2018 call-to-action for its community of tech security activists, the EFF wrote:

> If you care about protecting the safety of our online communities – if you care about protecting everyone's right to speak online, even about sensitive topics – we urge you to call your representative today and tell them to reject FOSTA.[44]

Hacking//Hustling

Evidence of the potential that exists in this mutually beneficial *crossing* and *knotting* of networks is Hacking//Hustling, a workshop, panel discussion, and community pop-up art show held in Brooklyn, New York in September of 2018. The two-day program of 'conversations and tactical skill sharing led by sex workers' was framed as:

> [...] a space for digital rights advocates, journalists, and allied communities to come learn from sex workers and better understand the developing effects of SESTA on internet freedom for all. We believe that sex workers are the experts on their own experience and that an internet that is safe for sex workers is an internet that is safe for almost everyone.[45]

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42 Norman Shamas, 'A Brief Introduction to Fosta-Sesta', October, 2018, https://www.genderit.org/sites/default/files/fosta_zine.pdf.

43 Anna Schecter and Dennis Romero, 'Sex Trafficking Law Becomes Center of Debate about Tech Responsibility', *NBCNews*, July 19, 2018, https://www.nbcnews.com/tech/tech-news/sex-trafficking-bill-becomes-center-debate-about-tech-responsibility-n892876.

44 Harmon, 'FOSTA Would Be Disaster'.

45 Melissa Gira Grant, 'Hacking//Hustling: A Platform for Sex Workers in a Post SESTA World',

The panel portion of the program brought sex workers and sex workers' rights activists together in discussion on 'censorship, discrimination, and policing in the wake of SESTA'.[46] Building on this panel, a workshop was organized in collaboration with t4tech, a group which seeks to empower trans and gender non-conforming people to participate in the tech industry.[47] The workshop was designed for sex workers and digital rights advocates to work together on implementing strategies to 'protect data, have safer communications, and build stronger online communities'.[48]

Unable to attend the program, I watch a live stream of the panel, feeling excited, yet undeniably anxious. As often happens when sex worker activists and advocates collaborate with other communities, the specific needs and experiences of sex workers – particularly those with the least institutional privilege – can become flattened and oversimplified, or co-opted toward some alternative end.

As such, connecting organizations and movements across difference demands an approach to collaboration that *encourages* multiplicity, honoring dialogue over unanimity. Often considered inherently detrimental or a sign of failure, conflict which emerges from *deliberating* rather than *dismissing* difference within a movement can do much to improve its efficacy and sustainability, make it more accessible, diversify its direction, or – and sometimes equally beneficial – encourage the movement to disperse and reform across time and space in radical ways.

What, then, might the rich and various formations and reformations of such a cross-network collaboration look like? I envision the establishment of a sustainable, sex worker-led hacker or maker space, a community-based learn-to-code program designed to the specific needs of local sex workers, or a well-attended and well-funded hackathon aimed at developing solutions for improved sex worker safety. I envision the creation of safe, adaptable, functional tools and strategies made accessible not only to those directly impacted by FOSTA-SESTA - sex workers with access to online resources in the first place - but to workers *without* that privilege. But, most of all, I envision this visioning happening *together*.

What is imperative is that this collaborative process centers the input and experience of marginalized communities that the very practice of *hacking* can be *hacked* to serve. Regarding FOSTA-SESTA specifically, if resistant technologies are not developed by and made accessible to the sex workers who desperately need them, it begs the question: *whose* identities are we collectively reproducing and why?

Breathing easy again as the Hacking//Hustling livestream comes to a close, I look into the faces of the driven, knowledgeable, and radical sex workers and techies who make up the panel and feel a touch of hope.

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http://melissagiragrant.com/hackinghustling/#resources.

46 Grant, 'Hacking//Hustling'.

47 'About', *t4tech*, https://t4tech-nyc.github.io/.

48 Grant, 'Hacking//Hustling'.

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‘Placeless’ Making? Rearticulating the Power-Geometries of Digital Platforms in China Through Tactical Co-Creation

Kat Braybrooke

'PLACELESS' MAKING? REARTICULATING THE POWER-GEOMETRIES OF DIGITAL PLATFORMS IN CHINA THROUGH TACTICAL CO-CREATION

KAT BRAYBROOKE



Fig. 1. Anonymous makers involved in this project and Kat Braybrooke, Shùjùxiàn sticker artworks that use WeChat to experiment with 'placeless making', screenshot, 2018.[1]

What happens when makers, or people who use tools[2] to hack, remix and create things, interact on virtual or 'placeless' rather than physical or 'locally situated' spaces? What happens when they encounter other digital actors – the kind who want to control them?

In China, internet surveillance is an everyday reality. Through an assemblage of tools referred to as 'The Great Firewall', the government monitors, classifies and censors the digital interactions of its 1.4 billion citizens. This reality is by no means limited to China, however. As governments and corporations alike realize the potentials of these technologies, internet censorship increasingly affects our digital experiences in many other places.

This article is about 數據線 *Shùjùxiàn,* or 'drinking from the data line', a creative experiment with digital makers in China that was inspired by Furtherfield's DIWO (Do It With Others) call in 2006 for decentralized endeavours that would disrupt hierarchies through networked collaborations.[3] By engaging in 'placeless making', projects like Shùjùxiàn attempt to playfully subvert censorship algorithms through co-creation.

1 Reprinted with permission of collaborators.

2 While makers use a variety of tools, from woodworking equipment to craft materials to advanced technologies like virtual reality headsets, to learn and create through material engagement, here I refer to 'digital making', which uses digital tools and platforms.

3 'DIWO - Do It With Others', *Furtherfield*, 2015, http://archive.furtherfield.org/projects/diwo-do-it-others-resource.

Introducing Placeless Making

As place becomes more important to platforms, so does placelessness. By 'placeless making', I refer to tactical projects that refuse to situate themselves, or situate themselves only temporarily, within any place. Placeless making explores making as a conceptual and technical practice[4] and as a politics of material participation,[5] supplanting local limitations with global networks of producers. In doing so, placeless making aims to enable alternative spatial configurations through material engagement.

From locally-situated hackerspaces, makerspaces and fab labs to the decentralized digital platforms in China, digital makers work in many different kinds of spaces. By engaging with these diverse arrangements, Shùjùxiàn aimed to explore whether placeless making could foster the kind of 'simultaneity of social practices without territorial contiguity' that Manuel Castells first referred to in 1999[6] when he spoke about the possibilities of renegotiating global 'spaces of flow'.[7] Shùjùxiàn opens up these possibilities by turning the geotagged environments of corporately-owned platforms like Instagram and WeChat into 'temporary autonomous zones'[8] for new modalities of co-creation.

It is important to emphasize here that engagements with digital platforms do not necessarily make it easy for the bodies of makers to transcend space and time – despite what the consensual dreams of cyberspace once promised us. Over and over again, we have seen how claims of digital emancipation are all too easily contested. In our current moment, place matters more, not less. We live in a 'new dark age', where nation-states increasingly capitalize on transnational networks of code, information, media and data – the very 'spaces of flow' referred to by Castells – in order to entrench their domination.[9] The politics of digital information, meanwhile, increasingly augment our spatial experiences. Sliced into digital layers, the stratified representations of local geographies on platforms like Google Maps critically influence how we understand and interact with places.[10]

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4 Matt Ratto, 'Critical Making: Conceptual and Material Studies in Technology and Social Life', *The Information Society* 27, no. 4 (1 July 2011): pp. 252-260, https://doi.org/10.1080/01972243.2011.583819.

5 Garnet Hertz, *Critical Making - Hertz*, Hollywood: Telharmonium Press, 2012, http://www.conceptlab.com/criticalmaking/.

6 Manuel Castells, 'Grassrooting the Space of Flows', *Urban Geography* 20, no. 4 (1 May 1999): p. 294.

7 Here a 'space of flows' is used to describe how the places of a space are articulated by networks of individuals, groups, software and hardware, who configure the spatial structures associated with flows of information according to their needs, as proposed by Manuel Castells, *The Network Society: A Cross-Cultural Perspective*, Cheltenham: Edward Elgar Publishing, 2004, p. 30. The value of this concept is that in configuration, there lies a possibility for reconfiguration.

8 Hakim Bey, *T.A.Z.: The Temporary Autonomous Zone, Ontological Anarchy, Poetic Terrorism,* Brooklyn: Autonomedia, 1985, https://theanarchistlibrary.org/library/hakim-bey-t-a-z-the-temporary-autonomous-zone-ontological-anarchy-poetic-terrorism; Simon Sellars, 'Hakim Bey: Repopulating the Temporary Autonomous Zone', *Journal for the Study of Radicalism* 4, no. 2 (2010): pp. 83-108.

9 James Bridle, *New Dark Age: Technology, Knowledge and the End of the Future*, London: Verso, 2018; Matthew Fuller and Andrew Goffey, *Evil Media*, Cambridge, MA: MIT Press, 2012.

10 Mark Graham and Matthew Zook, 'Augmented Realities and Uneven Geographies: Exploring the Geolinguistic Contours of the Web', *Environment and Planning A: Economy and Space* 45, no. 1 (1 January 2013): pp. 77-99.

Tactical Evasions, New Possibilities

Despite these realities, there are still opportunities to playfully 'hack' the flows of hegemonic platforms by rearticulating the logics of their creators. By refusing to locate interactions in any one place unless absolutely necessary, placeless making projects carry the potential, however nebulous, to challenge the entrapments of digital platforms. As the work of Zach Blas[11] reminds us, and Michel Foucault[12] before him, surveillance states have always attempted to utilize the newest technologies to identify, control and dominate their subjects. However, these dominations are contested by what Blas refers to as acts of 'informatic opacity',[13] tactical evasions seen in the creative endeavours of myriad groups from Pussy Riot to the Zapatistas, who experiment with visibility through 'carnivalesque refusal[s] of capture and recognition'.[14] Resistance inevitably persists.

By tapping into the legacies of these traditions, placeless making can subvert the dominant discourses of the spaces where they are located. Placeless makers can engage with two realms of possibility in particular.

First, placeless makers can decolonize the local hegemonies of global proprietary platforms by finding ways to exploit their 'hidden affordances',[15] or uses that are not apparent. Here, the stated intentions of platforms, and their embedded geolocational features, are creatively subverted to address other kinds of spatially heterogeneous needs. In her analysis of the media production of Black Lives Matter activists in America, for example, Chenjerai Kumanyika has discussed how informal groups of citizen journalists used mobile phone cameras and platforms like Facebook to explore the aesthetics of livestreaming practices in spaces of conflict.[16] By deliberately geolocating their own livestreams during protests, these portrayals provided an alternative to mainstream news coverage. This strategy fostered solidarity amongst international networks of protesters, but crucially it also enabled the exploitation of more vulnerable streamers by the media conglomerates and platforms they interacted with.

Second, placeless making can challenge the usual Western universalist assumptions[17] of what 'making' itself constitutes by enabling exchanges between different kinds of makers working across and beyond the local limitations and spaces of difference, from *jugaad* makers in India

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11 'Informatic Opacity', *The Journal of Aesthetics and Protest*, no. 9 (2014), http://www.joaap.org/issue9/zachblas.htm; Zach Blas, 'Opacities: An Introduction', *Camera Obscura: Feminism, Culture, and Media Studies* 31, no. 2 (1 September 2016): pp. 149-153.

12 *Madness and Civilization: A History of Insanity in the Age of Reason*, trans. Philip Howard, New York: Vintage Books, 1988; *Discipline and Punish: The Birth of the Prison*, trans. Alan Sheridan. New York: Pantheon, 1977.

13 Blas defines this as actions aimed at resisting state identity politics through acts of escape and opacity.

14 Blas, 'Informatic Opacity'.

15 Adrienne Shaw, 'Encoding and Decoding Affordances: Stuart Hall and Interactive Media Technologies', *Media, Culture & Society* 39, no. 4 (1 May 2017): pp. 592-602, https://doi.org/10.1177/0163443717692741.

16 Chenjerai Kumanyika, 'Livestreaming in the Black Lives Matter Network', in Amber Day (ed) *DIY Utopia: Cultural Imagination and the Remaking of the Possible*, Minneapolis: Lexington Books, 2016, pp. 169-89.

17 Elsewhere, I discuss with Tim Jordan the diffusion of globally heterogeneous making practices into a technomyth that claims they originated from a so-called American 'Maker Movement' in: Kat Braybrooke and Tim Jordan, 'Genealogy, Culture and Technomyth: Decolonizing Western Information Technologies, from Open Source to the Maker Movement', *Digital Culture & Society* 3, no. 1 (2017): pp. 25-46.

to *shanzaii* copyleft makers in China.[18] The hacktivists of groups like the decentralized Anonymous collective, for example, typically prefer their practices to remain placeless. In the mid 2000s, however, several members of the AnonOps group chose to work with local collectives of village elders, indigenous language experts, and educators in rural regions of Peru to subvert the 'techno-fundamentalist' one-size-fits-all software of MIT's One Laptop Per Child (OLPC) laptops that had been deployed in local schools. Anita Say Chan has described how these temporary transnational collaborations enabled the laptops to be 'rescripted' so that they could finally be suitable for the local contexts and languages of students.[19]

The Limits of Placelessness

In making projects of this kind, the spatial interactions between individuals remain defined by the limitations of the bounded territories within which their bodies and national identities are located. An AnonOps hacktivist may be able to transcend her usual spatiality by locating herself temporarily in rural Peru, but that does not mean her Peruvian collaborators share the same freedoms. If she finds herself on the wrong side of Peruvian laws, meanwhile, she may all too quickly lose her ability to build temporary autonomous zones across the spaces of the digital platforms she engages with.

One way of articulating these limits is through the geographer Doreen Massey's notion of space as an 'ongoing production'[20] that is both material and abstract in form, emerging dynamically from the interactions of multiple individuals, processes and histories. This allows the many places that make up a space to be viewed as overlapping 'envelopes of space-time'[21] that are variably articulated and perceived by different people at different moments in time according to the 'power-geometries', or social differentiations of mobility, agency and access,[22] that inevitably accompany their interactions with digitally-mediated spaces.

As we have seen in the examples above, these power-geometries, while often unseen, determine the affordances of those who engage with them according to spatial circumstances which are out of their control. By engaging tactically with these concepts through material engagement, placeless making is one of many efforts to negotiate this.

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18 Braybrooke and Jordan, 'Genealogy, Culture and Technomyth' ; Padmini Ray Murray and Chris Hand, 'Making Culture: Locating the Digital Humanities in India', *Visible Language Journal*, no. 172 (2013), http://visiblelanguagejournal.com/issue/172/article/1222.

19 Anita Chan, *Networking Peripheries: Technological Futures and the Myth of Digital Universalism,* Cambridge, MA: MIT Press, 2013.

20 Doreen Massey, *For Space*, Thousand Oaks: Sage Publishing, 2005, pp. 55.

21 Doreen Massey, *Space, Place, and Gender*, Minneapolis: University of Minnesota Press, 1994, p. 5.

22 Doreen Massey, 'Power-Geometry and a Progressive Sense of Place', in John Bird, Barry Curtis, Tim Putnam and Lisa Tickner (eds) *Mapping the Futures: Local Cultures, Global Change,* London: Routledge, 1993, pp. 59-69; Doreen Massey, 'Vocabularies of the Economy', *Soundings* 54, no. 54 (22 July 2013): pp. 9-22.

WeChat Stickers: A New Mode of Digital Making

I couldn't help but be preoccupied with these kinds of concerns while part of a research project that engaged with different kinds of maker communities in Xi'an and Chengdu, China, where the nation's dominant digital chat platform, WeChat, recently hit 1 billion monthly users. WeChat at first looks like WhatsApp and other chat services used in the West, but its inclusion of many additional functions, including e-governance and finance features, means it acts more like Facebook, Snapchat, a bank, and a national identification system, all rolled into one.

WeChat's group chat rooms, meanwhile, which can have up to 500 users, are utilized heavily by communities of makers, who create locally situated spaces for making by sharing code, designs and events. One maker I spoke to showed me how she had created two separate WeChat user accounts for herself once she hit the maximum groups per user, so that she could remain active in the 8,000 maker, craft and business groups she was a part of. Another maker explained that for him, 'WeChat is not just chatting software, it is community [...] I cannot live without it'.

It is no secret in China that the platforms that have not already been banned by its Great Firewall are typically those which have been sanctioned by the Party. WeChat in particular is known for its strict regulatory environment,[23] which continues to foster suspicions that its content may be monitored. According to Citizen Lab reports in 2016 and 2018, over 170 phrases (such as the keywords for 'student democracy movement') trigger immediate censorship, with more added dynamically from emerging news.[24] In addition, the reports demonstrate that visual algorithms are now being used to filter certain images.[25]

Revelations about WeChat's surveillance tactics, however, have not yet dampened the playful acts of digital making which have produced the platform's most chaotic, strange, and wonderful aesthetic outputs: *Biaoqing*, or stickers. These are customized GIFs and images that have been digitally created, remixed and then exchanged by more than 90% of WeChat users in order to disseminate memes, jokes and personal statements amongst their networks.[26] Many of these stickers are spread virally, appearing as crude illustrations and hastily Photoshopped images and ranging from 'Kim Kardashian getting thrown into a toilet' to 'testicle man', also known as 'Eunuch playing eggs'.

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23 Citizen Lab has explained that the Cyberspace Administration of China (CAC) tightened its regulation of WeChat in 2014 with the 'WeChat ten doctrines' which consolidated government content control over user activities.

24 Lotus Ruan et al., 'One App, Two Systems: How WeChat Uses One Censorship Policy in China and Another Internationally' (Citizen Lab, December 1, 2016), https://citizenlab.ca/2016/11/wechat-china-censorship-one-app-two-systems/.

25 Jeremy Knockel et al., '(Can't) Picture This: An Analysis of Image Filtering on WeChat Moments' (Citizen Lab, August 14, 2018), https://citizenlab.ca/2018/08/cant-picture-this-an-analysis-of-image-filtering-on-wechat-moments/.

26 'Chinese Netizen Expression Report', *Tencent*, 2014, https://data.qq.com//article?id=2507.



Fig. 2. Anonymous makers involved in this project and Kat Braybrooke, typical remixes of a reaction sticker on WeChat commonly referred to as 'mushroomboy head'. Statements include 'I surrender; your posing is too impressive', to 'poverty limits my imagination', 'let's go, mantis shrimp!', and 'stop typing, use more images', screenshot, 2018.

As Zeng Yuli has shown, the power to create and distribute stickers lies in the hands of WeChat users themselves.[27] Because of this, they have come to represent qualities of decentralization, individuality and irreverence – especially amongst young people. By providing a new generation with opportunities to express themselves as digital makers for the first time through the production of these small media artifacts, a unique aesthetic is being fostered, one which ever so slightly challenges centralized ideologies through the irreverent discourse of 'icons thick with meaning'.[28]

Shùjùxiàn: Drinking from the data line

To examine the possibilities for subversion embedded in the process of creating WeChat stickers, Shùjùxiàn aimed to explore whether the power-geometries or differentiations of agency, access and mobility that defined the 'particular envelopes of space-time'[29] experienced by Chinese makers could start to be rearticulated, or at least challenged, through the

27 Zeng Yuli,'Why Young Chinese Are so Crazy about Online Sticker Sets', *Sixth Tone*, 5 September 2017, https://www.sixthtone.com/news/1000812/why-young-chinese-are-so-crazy-about-online-sticker-sets.

28 Christina Xu, 'A Field Guide to China's Most Indispensible Meme', *Motherboard* , 1 August 2016, https://motherboard.vice.com/en_us/article/bmvd74/china-meme-face-a-biaoqing-field-guide.

29 Massey, *Space, Place, and Gender*, p. 5.

tactical practices of placeless making. While our interactions would, by necessity, be stratified according to our locations, I wanted to see whether there was a way to harness the possibilities of Blas' informatic opacity to enable a critical making discourse that did not violate the rules of WeChat censorship algorithms.

After testing out various creative anti-tracking tactics with the help of makers based in the U.K, the decision was made to create a set of six collaborative artworks. Each artwork would be generated from a combination of free or open source apps where possible, in order to see how difficult it would be to enable a sense of playfully muddled placelessness by manipulating the spaces of WeChat without using advanced tools. Our Chinese collaborators discussed how most young people had long suspected their chats were individually monitored, and therefore already self-censored their digital interactions. 'I know it sounds funny', they added, 'to say this, because we do not even know what they can and cannot hear. What if they do not hear at all?'[30]

The project proceeded to engage in a series of lively and seemingly innocuous sticker exchanges on WeChat with eight makers. These makers, who usually worked on physical fabrication or craft projects at makerspaces across China, donated stickers that had been created by themselves and others WeChat users. Each sticker conveyed – albeit in a non-explicit way – their thoughts on the confusing nature of what digital surveillance could mean. The stickers were then converted into MP4 video screen-grabs, and glitched using a variety of methods. From the screen-recording app CamStudio to the hidden GIF-layering qualities of Instagram, these glitch processes produced deliberately grainy – and some might argue, especially bad-quality – outputs. In doing so, the aim was to make their contributor chains especially difficult to trace.

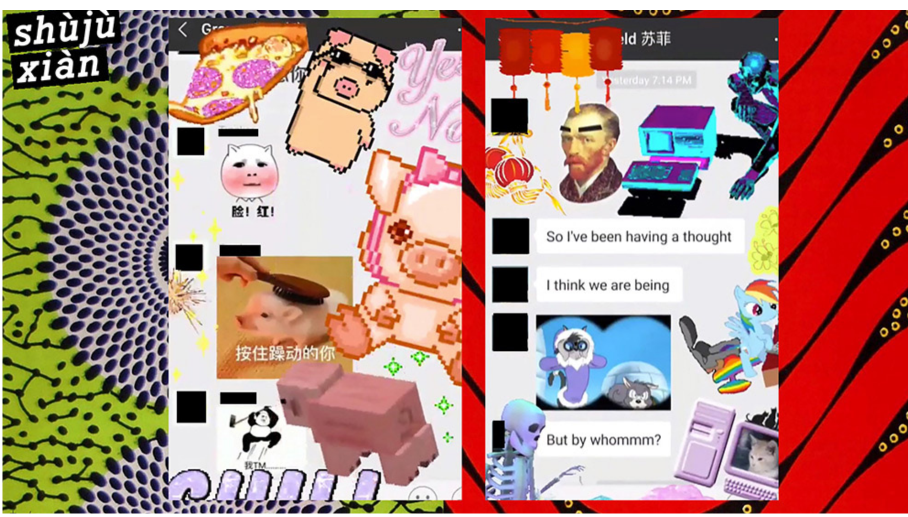


Fig. 3. Anonymous makers involved in this project and Kat Braybrooke, the initial sticker exchanges of Shùjùxiàn are remixed using glitching apps, screenshot, 2018.[31]

30 Personal communication, February 2018.
31 Reprinted with permission of collaborators.

Conclusion: The Small Triumphs of Placeless Making

The result of the Shùjùxiàn process was six digital artifacts, produced collaboratively with eight anonymous makers. In one co-creation, a maker's rendition of their own face was remixed into a series of animated GIFs, including one where they eat a watermelon and then cry, and one where they offer a heart with a fake smile, and then withhold it at the last minute. These GIFs expressed, without using text, the mixed feelings they felt about their continued dependence on WeChat. In another, a maker uses GIFs from children's films related to watching, listening and hunting to exemplify the many forms that digital surveillance might take. These largely wordless contributions remain uncensored in the sticker exchanges that continue to proliferate across WeChat's interfaces, artifacts of a lively flow of information which the artworks of Shùjùxiàn are now proudly a part of.

As a modest effort in experimenting with the tactical and playful practices of placeless making, Shùjùxiàn allowed my collaborators and I to reimagine ourselves – even if only briefly – as members of a temporary autonomous space where transnational co-creation could persist on even the most tightly controlled digital platforms. While we were able to contest the power-geometries of stratification that regulated the spatial freedoms of those involved by confusing a few of its minor stewards – in this case, the algorithms that log and censor user interactions on WeChat – I cannot claim that our creations amounted to anything more transformative than that.

However, when the six digital artworks of Shùjùxiàn were featured at the Mozilla Festival in the autumn of 2018 in London as part of its annual 'Artists Open Web' exhibit, eight unnamed makers across China were silently incorporated into exactly the kind of decentralized community of co-creators that had been envisioned by the DIWO movement in 2006. In their quiet evasion of visibility, they too joined the ranks of many others who have creatively engaged in carnivalesque pursuits of opacity – and will continue to do so – enabling new kinds of spatial configurations and transgressions in their wake.

Acknowledgements

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Fabbing the Chinese Maker Identity

Xin Gu & Pip Shea

FABBING THE CHINESE MAKER IDENTITY

XIN GU AND PIP SHEA

On a Thursday afternoon in June 2017, David Li, the poster boy of maker culture in China, showed us around the Shenzhen Open Innovation Lab (SZOIL). SZOIL is in Futian, an area of Shenzhen that offers tax breaks for the Creative Industries.[1] SZOIL is located in a creative cluster known as the Sino High Tech Industry Park. Surrounded by a multitude of high-rises, it was still under construction and had a limited sense of a 'lived' community. In one area of SZOIL, a group of American students were involved in a workshop surrounded by 3D printers, scanners, laser cutters and other hand tools. An agreement from MIT CBA[2] hangs on the wall confirming SZOIL as an official Fab Lab. The absence of local makers came as a surprise to us but is not unusual for Chinese makerspaces. According to David:

> SZOIL, like many makerspaces in the city, plays more of a role of an intermediary between foreign makers looking for a soft landing in Shenzhen and local manufacturing supply chains. These makerspaces offer a one stop shop to makers who want to make, prototype, manufacture, market, and distribute their goods via makerspaces.[3]

The Chinese maker identity has many influences. However, images of university graduates turned creative entrepreneurs and peasant workers using sophisticated technologies make up the dominant 'maker culture' narrative. Similar to constructions of maker identity in the West, these stories represent technology as an enabler, a method of empowering the disempowered. In contrast, our study of China's makerspaces supports Anita Chan's position – 'counter-movement' activities designed to broaden participation from developing regions has instead resulted in the normalization of Anglo-Saxon rule and neoliberal market mechanisms. This, in turn, benefits the parts of the digital knowledge economy capable of operating in transnational markets.[4] Despite attempts by the Chinese State to socially engineer maker culture, identities are also influenced by global makers, maker spaces, foreign states, and corporations. This universalist knowledge development demonstrates the power of the developed West in the global knowledge economy. Consequently, this reveals the difficulties in creating alternative modes of knowledge production, even for an economic powerhouse like China.

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1 Justin O'Connor and Xin Gu, 'A New Modernity? The Arrival of "Creative Industries" in China', *International Journal of Cultural Studies,* 9.3 (2006): pp. 271-283.

2 Massachusetts Institute of Technology (MIT)'s Centre for Bits and Atoms (CBA) and the Fab Foundation offer a Fab Lab certification if makerspaces subscribe to its charter http://www.fabfoundation.org/index.php/what-qualifies-as-a-fab-lab/index.html.

3 Interview, 24 July 2016, in Shenzhen.

4 Anita Chan, *Network Peripheries: Technological Futures and the Myth of Digital Universalism*, Cambridge, MA: MIT Press, 2013.

Shanzhai

Current manifestations of Chinese maker identities cannot be decoupled from *Shanzhai*, the term commonly used to describe the production of imitation goods. Shanzhai emerged out of China's declining manufacturing industry and its less-developed creative production culture.[5] Contemporary maker culture has even been referred to as 'the new Shanzhai'. However, with its lack of adherence to IP laws set by international agencies such as the WTO, the innovation system underpinning Shanzhai is deemed incompatible with the global digital economy.[6] For this reason, makerspaces in China are deployed as social mediators to reframe traditional manufacturing industries as a new form of digital creative economy.

Social shifts have seen China's manufacturing workforce accept new terms of work required by the new knowledge economy. This position is likely to be supported by 'borrowed' maker culture than by the local Shanzhai culture. The latter is about 'copying' – mastering techniques of production at scale – and is thus concerned more with sustaining manufacturing than replacing it. The politics of maker culture, on the other hand – open, democratic and flexible specialization carried out by new kinds of 'maker agents' (risk taking, free spirited and locally embedded) – entails values commonly shared by the global knowledge economy as well as the state trying to catch up with the West.

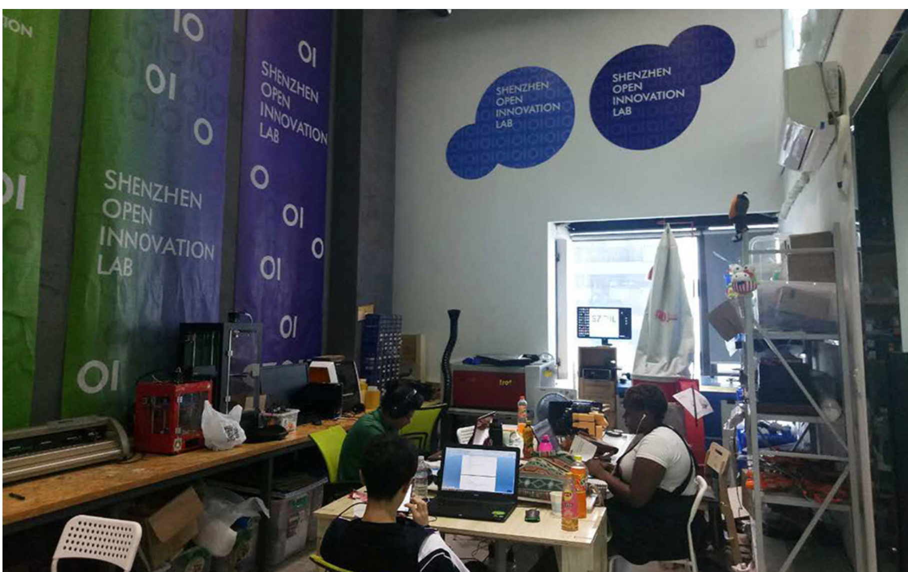


Fig. 1. Xin Gu, American students' maker workshop at Shenzhen Open Innovation Lab, 2017.

5 Will Hutton, *The Writing on the Wall: Why we must embrace China as a partner or face it as an enemy*, New York: Free Press, 2006.

6 Anastasia Loginova and Irina Mikheeva, *The Impact of WTO Membership: A Comparative Analysis of China, Russia, and Ukraine,* London: Routledge, 2018.

The State

Chinese maker culture is shaped by Creative Industries policies. This makes it difficult to see emergent maker identities as separate from a program of state-led social engineering. In contrast to the West, where maker identities are often underscored by a desire to subvert the dominant paradigm, the Chinese maker identity is being developed from the top down. Furthermore, the makerspace model is used by 'creative clusters' as marketing tools to conceal the new wave of urban gentrification in many post-industrial cities.[7]

In previous work, we have argued that institutionalized makerspaces (such as those in China and Northern Ireland) cannot be divorced from top down processes of nation building, as a range of strategic public policy agencies are involved, despite low public participation rates.[8] For example, the state-influenced corporation Foxconn, a global leader in mobile phone manufacturing, has invested heavily in maker industries as a way of leveraging the less structured organizational logic of makerspaces. The development of maker industries as a new inner-city economy – one adopted by post-industrial cities to replace traditional manufacturing – offers a counter to more techno-utopian views of maker culture in China.

Chinese makers now play an important intermediary role in between foreign makers, investors, and local manufacturing supply chains. This provides evidence that Chinese maker culture has a genuine interest in disrupting global hierarchies in the digital knowledge economy. Mass manufacturing industries are being rapidly forced out of Chinese cities. Debates around a shift towards a new economy based on 'post-Fordist' forms of production, information and communication networks, and a revised correlation between 'culture' and 'economy' are making headway in Chinese policy circles.[9] Makers and makerspaces play a key role in this revision, as 'social mediators' of the transition towards a knowledge economy situated between manufacturing industries and global technology markets.[10]

The West

Many Chinese makerspaces champion activities that have emerged from a very Western version of do-it-yourself (DIY) methods. Similar to Western makerspaces, their participants are predominantly well-educated, middle class, and urban university graduates.[11] Chinese makerspaces also represent a work context outside the confines of the bureaucratically controlled workplace, one that is perceived as more rewarding, meaningful, exciting, and glamorous. And they are also underpinned by the same misleading premise: that anyone

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7 Xin Gu, 'The paradox of maker movement in China', in Jeremy Hunsinger and Andrew Schrock (eds) *Making Our World: The Hacker and Maker Movements in Context*, New York: Peter Lang, 2018, pp. 271-291.

8 Pip Shea and Xin Gu, 'Makerspaces and Urban Ideology: the Institutional Shaping of Fab Labs in China and Northern Ireland', *Journal of Peer Production*, 1.12 (2018): pp. 1-16.

9 Justin O'Connor and Xin Gu, 'A New Modernity? The Arrival of "Creative Industries" in China', 2006.

10 Pip Shea and Xin Gu, 'Makerspaces and Urban Ideology'.

11 Silvia Lindtner, 'Hackerspaces and the Internet of Things in China: How makers are reinventing Industrial Production, Innovation, and the Self', *China Information* 28.2 (2014): pp. 145-167.

can make anything.[12] However, Chinese makerspaces are very aligned with established manufacturing industries. For example, *Seeed Studio* is a key player in Chinese maker culture. The company manufactures hardware that leverages foreign ideas sourced from the crowd funding website *Kickstarter*. Seeed Studio supports a local makerspace called *Chaihuo* that develops technology solutions through grassroots social justice initiatives. Although Chaihuo displays traits in line with Western constructions of maker culture, its relationship with Seeed Studio sees it more closely aligned with traditional Chinese manufacturing.

In the West, self-directed acts of citizenship, or 'DIY citizenship'[13] have also been associated with maker culture.[14] It is important to note that these self-directed practices derive from people who have the capacity and agency to perform in non-normative ways. It is important to highlight this in the Chinese context as it creates new conditions of exclusivity.[15] Dunbar-Hester's work[16] sheds historical light on this trait, revealing that 'DIY itself has traditionally not been for just "anyone"' because the original DIY movement of the 60s and 70s also championed a version of self-directed home improvement codified with white maleness. Furthermore, maker culture privileges the historically masculinized practices of engineering, computer programming, and amateur electronics.[17] Those who inject this 'universalist' view into the propagation of technology may reproduce the very same conditions where exclusion and hierarchies are present. If Chinese maker culture is to create an alternative space for technological and political participation, it has to address structural societal exclusion, whilst critically reflecting on local contexts.

Critical Making – a Fallacy?

Scholarly Critical Making describes a method of making that emphasizes critical reflection of the materials being worked with.[18] As a practice, it aims to challenge existing systems of authority by rallying against incumbent industrial paradigms. The challenge inherent in situating Chinese makers as 'critical makers' therefore lies in its close alignment with existing manufacturing infrastructures and assemblages. More precisely, the Chinese maker context is pushing for the disruption of Western-centric digital knowledge econo-

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12 This widely quoted phrase by MIT Professor Neil Gershenfeld (Fab Lab co-founder) underpins maker culture dogma.

13 Matt Ratto and Megan Boler, 'Introduction', in Matt Ratto and Megan Boler (eds) *DIY Citizenship: Critical Making and Social Media*, Cambridge, MA: MIT Press, 2014.

14 Pip Shea, 'Hacker agency and the Raspberry Pi: Informal Education and Social Innovation in a Belfast Makerspace', in Jeremy Hunsinger and Andrew Schrock (eds) *Making Our World: The Hacker and Maker Movements in Context*, New York: Peter Lang, 2018, pp. 237-254.

15 Christina Dunbar-Hester, 'Radical Inclusion? Locating Accountability in Technical DIY', *DIY Citizenship: Critical Making and Social Media,* Cambridge, MA: MIT Press, 2014, pp. 75-88.

16 Dunbar-Hester, 'Radical Inclusion'.

17 Pip Shea, 'Civic Practices, Design, and Makerspaces', in Anthony McCosker, Sonja Vivienne and Amelia Johns (eds) *Negotiating Digital Citizenship: Control, Contest, and Culture,* London: Rowman and Littlefield, 2016, pp. 231-246.

18 Matt Ratto, 'Critical Making: Conceptual and Material Studies in Technology and Social Life', *The Information Society* 27.4 (2011): pp. 252-260.

my hierarchies, rather than their own industrial processes. Attempts to further situate Chinese makers as 'critical makers' must also seek to understand the arrangements of power affecting acts of making.

Shanzhai is interesting in the Critical Making context because it is concerned with the growing consumer demand for cheap, personalized mobile phones with a short shelf-life. It addresses some of the barriers to innovation related to the rising cost of R&D in traditional manufacturing industries, and recognizes the sociocultural context that small and micro businesses can innovate within. A key claim of Shanzhai is to replace the technical division of labour in traditional factories with a multi-skilled workforce empowered to make complex decisions in product innovation.

In contrast, the Western maker culture narrative emphasizes disrupting the social order through the demystification of technology – or alternatively, the nurturing of maker agency through critical making practices. This belief conforms to western DIY citizenship in that those with limited technical skills may identify strongly with politics of making. But this belief falls short of comprehending the social reality in China. Participation in the maker movement requires not only technical skills but resources such as time, capital, and creative thinking that are accessible only to the privileged few. Social inequality within China remains widespread, and current manifestations of maker culture – as the exclusive domain of the knowledgeable, the entrepreneurial, and the creative – could exacerbate the already severe socioeconomic divide in the country. On top of this, the privileging of foreign makers as creative agents capable of political participation versus local (less creative) ones re-creates inequalities that maker culture was meant to disrupt.

Makerspaces have attempted to address this issue by engaging makers from novice groups, including peasant workers and retirees. However, most of these participants had engineering or design backgrounds, and almost all had university degrees. This attempt to promote a universalist politics of maker agency represented the structural difficulties in promoting technology-induced empowerment. This difficulty is largely due to Chinese maker culture being less concerned with challenging the power differentiation associated with production and consumption, and more focused on collectively dealing with societal changes shaped by the technologies of globalization.

In China's maker culture, there are different attitudes towards 'making it'. Discourse within makerspaces tend to 'encourage all members to make' while asserting that 'not everyone can make it'. Certain individual makers 'just want to have fun', 'make friends outside work' and 'practice English'.[19] Ultimately though, participants are there to utilize existing manufacturing infrastructure rather than develop emancipatory practices.

Challenges in the Development of Chinese Maker Agency

Based on our observations of Shenzhen's maker spaces since 2016, it is clear that participation in makerspaces resembles characteristics of precarious work in the broader Creative Industries. In addition, this precariat was engineered by an intention of a middle class aiming at scoring political points. Shenzhen's maker culture provides evidence that participation in

19 Interview, 28 June 2016, in Shenzhen.

non-proprietary technology 'gift economies'[20] does not deliver individual emancipation. They reiterate that the Western vision of open, participatory innovation masks the corporate capitalization of voluntary labour. This echoes Sharon Zukin's critique of the somewhat related practice of hackathons. Such 'ritual(s) of ecstatic labor'[21] functioned as a way to 'manufacture consent' towards precarious work in the new creative industries. As access to digital making technologies increases in China, the social momentum of differentiation has the potential to create new kinds of inequality. Issues pertaining to digital literacies are a product of class caused by the construction of new systems of inclusion and exclusion.

The pursuit of the 'the shock of the new' associated with DIY making can be repositioned as a key value for class stratification. These versions of free, individualized, artisanal innovation emerging from the wreckage of mass manufacture are unlikely to create the participatory environment for those disenfranchised in society. The gap between working-class culture represented by Shanzhai and middle-class culture grounded in makerspaces, corporations, and the state cannot easily be bridged by Western universalistic rhetoric. Makers and makerspaces increasingly look towards Shanzhai for inspiration, promoting it as the origin of Chinese technical culture. Aligning maker culture with Shanzhai offers an important local context, but doesn't negate that building structures of participation (like makerspaces) can be difficult to implement in China.

Our study noted an emergent resistance from local communities who questioned the legitimacy of a universal maker culture. They see the new concept of Shanzhai 2.0 as more appropriate in addressing local problems such as automation and gentrification. Shanzhai 2.0 elevates practices that are descendants of the old industries. They also acknowledge that the development of maker agency in the Chinese context has to address historically limiting factors to technical participation – issues such as limited access to technology, limited creative agency, and labour exploitation. How cultural democracy is maintained or suppressed as part of the infrastructures of making also warrants a more focused research agenda. A 2014 study of internet censorship in China provides sight lines for the limits of the maker movement in China.[22] The very notion of a DIY citizenship linked to sociopolitical change runs into conflict with China's internet censorship, a regime that routinely removes content deemed to promote collective action. This indicates that the universalist logic of maker culture might be beyond the frame of the Chinese sociopolitical system.

An Alternative Politics of Making?

The accommodation of individual creativity within Chinese maker culture is emerging through a nationalized creative economy paradigm focusing on cultural consumption and individualism. Far from enabling widespread participatory culture-making, Chinese maker culture is a source of aspirational stories of personal ping pong training machines and nuclear decommissioning

20 Tiziana Terranova, 'Free labor: Producing culture for the digital economy', *Social Text* 18.2 (2000): pp. 33-58.

21 Sharon, Zukin and Max Papadantonakis, 'Hackathons as Co-optation ritual: Socializing workers and institutionalizing innovation in the "new" economy', in Arne Kalleberg and Steven Vallas (eds) *Precarious Work*, Bingley: Emerald Publishing Limited, 2017, pp. 157-181.

22 Gary King, Jennifer Pan and Margaret Roberts, 'Reverse-engineering Censorship in China: Randomized Experimentation and Participant Observation', *Science,* 22 August 2014, pp. 1-10.

robots. Such examples rise to the surface as they represent 'playfulness', 'openness', 'passion', and 'sociality' – terms that privilege Western maker culture ideologies over a local emphasis on structural efficiency. Furthermore, the involvement of corporations and the state in shaping Chinese maker culture hints at an ongoing top-down organizational paradigm.

If the socially democratic ideals of digital universalism are to infiltrate China on a meaningful level, then attention must be focused on its broader cultural and social structures. The debate has to move beyond the politics of 'resource ownership and user agency', instead focusing on the correlation between socioeconomic shifts within publics and traditional structures which create problems for participation. We must also be mindful of the effects of technological automation – a celebrated aspect of maker culture – on employment. Workers from traditional manufacturing may resist maker culture as it represents a threat to their existing labour arrangements.

This is not the first time that China has embraced a Western model of development. More often than not, Chinese 'modernization' has meant learning not just technical and administrative solutions but Western cultural forms and values. This tendency once again raises persistent questions: What can be mobilized from one's own tradition? What and how much to borrow? And what social, cultural and political changes might follow in their wake? These questions are yet to find their answers in Chinese maker culture. Responding to these challenges will be key for creating an alternative space that is not confined to the logics of digital universalism.

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Maker-Activists in the Post-Growth City

Cindy Kohtala
& Sharon Ede

MAKER-ACTIVISTS IN THE POST-GROWTH CITY

CINDY KOHTALA & SHARON EDE

Materialist grassroots groups (DIY maker-activists) not only create their own local products and technologies, but also spaces, communities, practices, narratives and economic models. They do so in participatory ways – deliberately pushing against consumerism, the anonymity of mass production, and the neoliberal policies of the cities they are within, where the goal of innovation is economic growth from which only few benefit. Whether they explicitly label their activities as 'post-growth' or rather implicitly experiment with post-growth, anti-capitalist, environmentally-oriented practices, these groups are both shaping and being shaped by techno-utopian urban narratives.

We've met and worked with DIY maker-activists,[1] mainly in wealthy European and Australian cities. Situated in makerspaces, these individuals and groups make things using digital fabrication equipment and computer-controlled tools like milling machines and laser cutters. Importantly, many groups we observe also involve themselves in urban activist initiatives such as gardening and agriculture, Right To The City[2] actions, and repair, reuse, and recycling events.[3] They offer compelling ways for other non- or semi-activist citizens to influence their own neighborhoods and cities. Their workshops (FabLabs, makerspaces, hacklabs, etc.) are often represented in urban imaginaries that depict smart, empowered citizens innovating, ecosystems of entrepreneurs circulating materials, and multi-generational and socioeconomically diverse social groups learning new skills together. Yet we see relatively little actual investment from public stakeholders into community workshops. What, then, does it take for a community technology workshop to setup, survive, and thrive in an urban area?

Some groups align with established institutions in order to gain wider audiences and build legitimacy. Others resist commodification, defending community values and retaining an alternative, countercultural identity.[4] Their decisions embed tensions and trade-offs, and it is as unhelpful to dismiss 'mainstreaming' as mere selling out or cooption as it to overlook maker experiments in post-capitalist organizing as too marginal to have any impact. In practice, activists are highly precarious. Despite the best intentions, workshops easily become new privatized spaces for elite consumption[5] and may even foster negative consequences such as gentrification.[6] These

1 See Fernanda Marin, 'Cosmo-Localization: Can Thinking Globally and Producing Locally Really Save Our Planet?', *OuiShare Magazine* blog, 27 November 2017; Eeva Berglund and Cindy Kohtala, 'Collaborative Confusion among DIY Makers: Ethnography and Expertise in Creating Knowledge for Environmental Sustainability', *Science & Technology Studies* (2018, ahead of print).

2 A concept attributed to Henri Lefebvre.

3 Berglund and Kohtala, 'Collaborative Confusion among DIY Makers', see also: David Schlosberg and Romand Coles, 'The New Environmentalism of Everyday Life: Sustainability, Material Flows and Movements', *Contemporary Political Theory* 15.2 (2016): pp. 160-181.

4 Cindy Kohtala, 'The Sociomateriality of FabLabs: Configurations of a Printing Service or Counter-Context?', *Journal of Peer Production* 12 (2018).

5 See Neil Brenner and Nik Theodore, 'Cities and the Geographies of "Actually Existing Neoliberalism"', *Antipode* 34.3 (2002): pp. 349-379.

6 See Paolo Cardullo, Rob Kitchin and Cesare Di Feliciantonio, 'Living Labs and Vacancy in the Neoliberal

trends suggest that the support of activist spaces requires more consideration in a post-growth city. Critical reflection would mean examining the ways these groups actually use these spaces to explore alternative economic models, localize aspects of production, and create value. It would also mean probing what roles municipal authorities and other stakeholders have in supporting these grassroots community spaces, along with their motivations for doing so. We consider the twin perspectives of both activists and city authorities because we too operate in these communities alternatively as researchers, observers, and organizers, but also as analysts, advocates, and activists.[7]

Currently DIY digital-making is espoused as disruptive, even as a pathway to a *sustainable industrial revolution*, but precisely how that revolution will unfold depends on how groups organize, with whom they align, and what commons[8] they identify as worth protecting. Some of the seemingly ephemeral choices being made today will be institutionalized, solidifying into tomorrow's post-industrial urban production infrastructure.

Paying the Rent, Planting Seeds

From the maker-activist's point of view, tensions arise due to their uneasy relationship with the institutions and infrastructures of the unsustainable present. Activists live precariously but may do so deliberately, preferring to live in drafty former factories and procure food by dumpster diving than earning a conventional salary. Being able to pay rent for space often depends on expanding a social networks of artists, designers, and other users who want access to shared workshop facilities, storage, and/or learning opportunities. They debate internally if activities to secure revenue for rent or individual income accord with capitalist logics.[9] Such spaces and their communities thus comprise a bricolage of the commercial and commodified, the unbranded, the experimental, and the hacked. These spaces signal opportunities for post-growth transformations. Yet activists often eschew the conventional middle-class lifestyle to such an extent that it is difficult to determine what lessons can be learned for wider society.

In one particular case we know of, an artists collective procured the rent for a self-organized, open access, free culture space from a charitable foundation for the first year and from crowdfunding the second year, but has recently had to close its doors. Similarly, in our own experience, the city was tolerant of our free culture urban greenhouse in Helsinki city center, which ran for seven years due to much volunteer effort and grants from cultural foundations. But the space's role in fostering an environmentally oriented, participatory cultural milieu in the city was not recognized until a year after the greenhouse was dismantled. Elsewhere we

City', *Cities* 73 (2018): pp. 44-50.

7 Cindy is a design researcher examining European FabLabs and their sustainability efforts. She has also been involved in several urban activist initiatives. Sharon is a public servant who has successfully advocated for funding for community-based shared fabrication spaces. She has a long track record of activism and expertise in fostering sustainable, post-growth urban development.

8 See David Bollier and Silke Helfrich (eds) *The Wealth of the Commons: A World Beyond Market & State*, Florence, MA: Levellers Press, 2012.

9 Javier Lloveras, Cathy Parker and Lee Quinn, 'Reclaiming Sustainable Space: A Study of Degrowth Activists', *Marketing Theory* 18.2 (2018): pp. 188-202.

have argued that the greenhouse planted seeds for another urban greenhouse to emerge five years later.[10] Here, activists learn through hands-on practice about renewable energy, gardening and food self-sufficiency, and making everyday items from discarded materials (e.g. soap from cooking oil, power banks from scrapped laptop batteries), inviting other citizens to these open workshops.[11]

Obviously these examples are not new. Artist and community technology collectives have long gathered in the wastelands and derelict areas of transforming post-industrial cities. Nor are cities compelled to support them. But we argue that the lack of acknowledgement (whether financial support or other recognition) erodes the potential of community workshops. These workshops provide relatively low-cost, low-risk opportunities for citizens to experiment with circularity and novel, low carbon, locally embedded, post-capitalist practices that depart from conventional profit-seeking.[12] Activists have often laid the groundwork for activities that others later profit from. Experimental prototypes are copied and commodified, becoming products and services. For maker-activists, contributions do not always need to be rewarded with money, especially as government funding is subject to the vagaries of political changes and shifting priorities. Acknowledgement of time, expertise, and labor is desired – but here activists are usually disappointed.

For advocates of open access, community-based workshops, investing in community development nourishes the seedlings of alternative, local economies. Given the conditions of enforced precarity that many face, these communities foster 21st century enterprise, where people are more empowered to MYOJ ('Make Your Own Job'). This is critical in a transitioning world where more traditional forms of employment are disappearing and more people are seeking to build a livelihood around their passions and skills. Indeed, some cities and organizations regard shared workshops as a 'common asset', much like a library, that offers services to the community.[13] Others see them as incubators, where people with expertise provide training, mentorship, and space for others to build enterprises such as cooperatives.[14] Other options for funding makerspaces as civic infrastructure include Community Land Trusts, where community assets are held in a trust and stewarded by a nonprofit entity on behalf of a community.[15] All these examples show that activist-authority relationships need not be reduced to mere financial transactions. For communities, there is a middle ground between government dependence and full autonomy that is being increasingly and creatively explored. Various operating models can be piloted, and diverse forms of partnership between activists, cities, and other stakeholders can be prototyped, planting seeds for future configurations.

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10 Cindy Kohtala and Andrew Paterson, 'Oxygen for Töölönlahti', in Eeva Berglund and Cindy Kohtala (eds): *Changing Helsinki? Eleven Views on a City Unfolding*, Helsinki: Nemo, 2015, pp. 64-70.

11 See https://kaantopoyta.fi.

12 See Bastian Lange and Hans-Joachim Bürkner, 'Open Workshops as Sites of Innovative Socio-Economic Practices: Approaching Urban Post-Growth by Assemblage Theory', *Local Environment* 23:7 (2018): pp. 680-696 .

13 See http://commonlibraries.cc.

14 Will Holman, 'Makerspace: Towards a New Civic Infrastructure', *Places Journal*, 2015.

15 Matthew Thompson, 'Between Boundaries: From Commoning and Guerrilla Gardening to Community Land Trust Development in Liverpool', *Antipode* 47.4 (2015): pp. 1021-1042.

Enabling Creative Citizens

The dilemmas activists face regarding money and income are common ones. They reveal the inherent contradictions in what cities think such shared community spaces are for – and what the city itself is for. Current definitions of success and innovation in wealthy post-industrial cities, even when not oriented to consumer capitalism, still tend to emphasize the individual rather than the communal. This partially explains the ubiquitous tendency to reduce DIY maker culture to romanticized (Western) notions of material engagement, resulting in a superficial catalogue of the most photogenic projects and the slickest workshop spaces. Some cities with active maker communities have attempted to exploit 'creativity' as a branding opportunity, especially when vying for European and regional funding. Drawing on the 'creative class' coined by urban planning scholar Richard Florida,[16] their goal is to promote their identity as a 'creative city'. But according to activists, authorities often end up supporting business-as-usual: incumbent enterprises that make no clear contribution to collective creativity, true innovation, or regional well-being.

However, there are examples that defy these disappointing outcomes. We visited one Nordic artist-designer collective where the city had provided grants not only to purchase a former factory, but also to renovate it (as a valued piece of urban industrial heritage). Moreover, the activists have been allocated grants to equip the building as a fully functioning community workshop for citizens. The large workshop and co-working spaces will serve local small business owners and freelance creatives in particular, but in essence they are facilities for everyone. The collective can then farm out design work to their freelancer network, offer facilities for the unemployed and underemployed to re-skill and improve their quality of life, and spend free experimental time on prototyping novel materials based on local waste streams.

The desire to support local creative communities, whether they be professionals or hobbyists, often takes the form of establishing a makerspace in a community center or municipal library. Other stakeholders – charitable foundations, cultural nonprofits, and industry associations – have also established open access workshops to these ends, and their stories are worth examining further. Several factors have contributed to the longevity of these workshops. In one case, there is a long-established history of community craft workshops in the region, making them familiar to local residents. Several spaces adopt long-term engagement strategies that integrate local residents into the makerspace, step by step, as responsible co-owners. These efforts entail impact assessments and indicators that depart – often radically – from the capitalist growth paradigm.

However, in general, the diversity of grassroots activist spaces has been challenging for outsiders to fathom. Authorities often struggle to grasp the difference between community-based, open access workshops and other facilities that offer commercial 3D-printing services, or are only open to employees of a company or to staff and students of an

16 Richard Florida, *The Rise of the Creative Class: And How It's Transforming Work, Leisure, Community and Everyday Life*, New York: Basic Books, 2002.

educational institution. Moreover, there is little recognition that urban areas have room for several types of activist spaces. Whether situated in libraries, staged as self-contained community workshops, or erected as more specialized open-access workshops, this diverse array of spaces could cater to a diverse array of people, from the professional to the hobbyist, from the inventor to the creative citizen.

Hacking Consumption Culture

Along with fostering employability, creativity, and a generally experimental milieu, there is potential for DIY maker-activism to encourage efforts towards urban environmental sustainability.[17] DIY makers, like environmentalist activists before them, often focus on challenges that institutional actors have failed to adequately address or sometimes even identify,[18] whether it is our accumulating piles of single-use plastic packaging or phosphorus cycles in our environment. From manipulating plastics into useful new materials in public workshops to experimenting with 'pee-ponics' systems in urban gardening, activists make these issues visible (uncomfortably at times) and directly confront them.

In one case we know, the municipality has given an entire industrial building in the city center to a design collective for free, for an entire year. This resource will allow them to experiment with plastic recycling, developing new materials and reusing existing ones. In contrast, in another city just two hours away by train, urban planners are attempting to sell an activist collective's living-and-working premises out from under them, despite the collective having secured enough funding to buy the building (including a FabLab) via crowdfunding. If they lose their premises, activists fear their neighborhood will become gentrified by developers converting industrial buildings into high-income housing. At the same time, this collective has a champion in a different municipal department who has invited the activists to lead local 'citizen science' educational projects, which has financially sustained them for several years and has provided the region with valuable citizen-gathered data on waterways.

In our observations, activist-makers reject the eco-modernist techno-fixes that characterize so much of the current green economy discourse, especially in cities. Makers may embrace sensors and mass-produced circuit boards, for instance, but these are integrated into 'appropriate', localized, customized assemblages of their own making, which resist commodification. Many are interested above all in process – in getting together to problematize and ask better questions, rather than to 'solve problems'. These projects, from beehives to vermicomposting boxes and permaculture initiatives, indicate a committed examination of what urban environmental sustainability could mean. Through constantly probing and prototyping alongside each other, activists encourage *collective* action in dedicated spaces and places.[19]

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17 Schlosberg and Coles, 'The New Environmentalism of Everyday Life'.
18 Berglund and Kohtala, 'Collaborative Confusion among DIY Makers'.
19 We therefore acknowledge activists' own use of other terms for their work, DIT for Do-It-Together and DIWO for Do-It-With-Others, even when we simplify by talking about DIY.

From the perspective of advocates, the concept of community workshop can be framed as a type of 'enabling infrastructure', as municipal budgets for infrastructure are often much bigger. If infrastructure enables an activity to occur, then space and the rent required to access space *is* infrastructure. If a municipality or regional authority has budget for waste and recycling infrastructure, an argument can be made for 'transplanting' some of that funding to the upper part of the materials hierarchy.

Conclusions: Prototyping Possibilities

The examples we have given illustrate the tensions in making attractive and liveable cities in a post-growth era marked by significant economic uncertainty and environmental crisis, and the role of makers' community workshops within them. It is too easy to romanticize makerspaces and empowerment-wash them as beneficial. While there are many claims regarding how makers are making production more local and more sustainable, there is little actual evidence. At the same time, urban innovation and enterprise need not be measured only in neoliberal terms – as commercialized packages, conventional services, and proprietary products – but instead might be understood as the ongoing life-forces of local residents doing things together. Certainly this 'free and open source' model is not business-as-usual and must be learned. However, a counter-culture community workshop can be 'domesticated' into a sustainable city in various ways, fulfilling the requirements of municipal spending and the challenges of decision-making without compromising the community's ideals.

Our own experiences and observations indicate some of the ways shared workshops can remain sustainable: with targeted support that does not constrain the needs of activists for openness and pursuing idealistic projects; with strategies that draw stakeholders and activists into co-ownership; by supplementing the most experimental spaces for specialized makers with familiar community assets that are more broadly inclusive, accessible, and educative, such as library makerspaces; and by collectively redefining what makes a successful city. By asking activists what commons they are protecting, and by asking cities and stakeholders to define post-growth indicators, the implications of a community workshop might be better articulated. These questions would help both actors find common ground and shape their dialogue on future pathways.

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Towards Feminist Labs: Provocations for Collective Knowledge-Making

Maya Livio
& Lori Emerson

TOWARDS FEMINIST LABS: PROVOCATIONS FOR COLLECTIVE KNOWLEDGE-MAKING

MAYA LIVIO AND LORI EMERSON

In recent years, the lab as a site of knowledge production has increasingly become commonplace both within and outside of academic institutions, beyond the established lab-based disciplines of the fundamental and applied sciences. The increased prevalence of labs suggests that scholars and practitioners are actively pursuing new models for knowledge production, moving away from ideals of solitary work and towards collaborative, experimental, and interdisciplinary research approaches. However, despite the apparent newness of labs, their dominant lineage stems from a racist, sexist, and colonial past, bringing methods, infrastructures, and underlying assumptions along with it. These handed-down affordances may inform the ways in which lab work is structured, and in turn, shape the kinds of knowledge that labs produce. In this paper, we argue that contemporary labs, as spaces of collective and interdisciplinary thinking and doing, require their own consideration as sites for feminist methodology.

In order to examine lab practices, it is important to first examine their multiple origins. Early proto-lab spaces included sites like monasteries, workshops, and kitchens – spaces which were never called labs but had many of the elements associated with 'labness' such as a source of heat, a central worktable, open and flexible work areas, a library, and a surrounding collection of tools and materials. The most commonly recognized provenance of labs is found in the anatomical theaters and apothecaries of the 16th century, and this century is generally considered the time at which entities properly called 'laboratories' emerged. However, if we include the many sites of experimental work that surfaced later on in the late 17th century, examples of proto-labs should also include – as Steven Shapin points out – a motley assortment of venues, including the private residences of 'gentlemen', 'sites where places of scientific work were coextensive with places of residence'.[1]

The fact that places of scientific experimentation migrated further into private homes for a time points again to the importance of kitchens as integral to the history of labs, and is of particular relevance to our essay. Women have, of course, long been relegated to the kitchen as the heart of the domestic sphere and, as Alix Cooper points out, in early modern times 'kitchens and basements or root cellars formed improvised laboratories for women to tinker with and write down medical recipes'.[2] With the gradual appropriation of the kitchen as a place for 'gentlemanly' experimentation over the span of the 18th and early 19th centuries, women were essentially given the bizarre and contradictory message that they belong in a kitchen, that the kitchen might in fact be a lab, but that a lab is not for them.

1 Steven Shapin, 'The House of Experiment in Seventeenth-Century England', *Isis*, A Special Issue on Artifact and Experiment 79:3 (September 1988): p. 378.

2 Alix Cooper, 'Homes and Households', *The Cambridge History of Science*, Vol. 3: Early Modern Science, Cambridge: Cambridge University Press, 2006, p. 227.

Not surprisingly then, the 19th century ushered in the all-male industrial research laboratory, largely pioneered by Thomas Edison at Menlo Park, New Jersey. A so-called 'invention factory' and the largest private lab in the U.S. in the 1870s, Menlo Park simultaneously built on and departed from the long history of kitchens, apothecaries, theaters, and chemistry labs which we briefly summarize above. As Darren Wershler et al. point out in *THE LAB BOOK*, Edison's lab drew on the spatial, infrastructural, and administrative organization of labs and, with its frenzied embrace of entrepreneurialism and innovation, laid the groundwork for most of the major technology-based labs to come in the 20th century.[3] A lab such as the MIT Media Lab, then, is founded upon these archaeological layers. The significance of this particular lineage of labs here is that contemporary interdisciplinary labs are inevitably built on some of these inherited value systems. The project of colonial science itself has deep ties to labs, as Kathryn Yusoff reminds us in *A Billion Black Anthropocenes or None.* Yusoff outlines how, beginning in the mid-1940s, an entire community of Marshallese residing in the Pacific islands were removed from their homeland so that it could be used for nuclear testing. Even though the Marshallese were placed in nearby islands, they were exposed to radioactive ash after the U.S. carried out its largest nuclear detonation, 'Castle Bravo', in 1954. 236 Marshallese were 'treated as test subjects for the effects of radiation', which for Yusoff is comparable to Hortense J. Spillers's description of medical experimentation on sick Black Americans, in that 'the procedures adopted for the captive flesh demarcate a total objectification, as the entire captive community becomes a *living laboratory*'.[4]

While labs bear with them the potential to set a particularly harmful praxis into motion, they are malleable entities and contain potentialities for new world-making practices. Therefore, inspired by boyd and Crawford's 'Six Provocations for Big Data',[5] we offer here six provocations for feminist lab work – following hooks's call to bring feminist theory 'into the streets' by bringing it 'into the suites' of lab-based knowledge production.[6] Our provocations are grounded in established feminist methodological concerns, which we have developed and applied towards the collaborative knowledge-work of labs. They are far from comprehensive, and while we do aim for the concrete, are not intended as step-by-step methods, but rather as methodological probes that can be used in the development of site-specific lab protocols. We believe that these protocols must always be situated and collectively established within the community, time, and place in which they are mobilized.

Throughout, we insist on the importance of moving beyond issues of inclusion when making labs more feminist. To be clear, it is urgent for marginalized and underrepresented peoples to be included in lab leadership, membership, and communities. Conversations about how to include these groups in labs and other knowledge-making spaces, commonly echoed in

3 Darren Wershler, Jussi Parikka and Lori Emerson, *THE LAB BOOK: Situated Practices in Media Studies,* unpublished manuscript, in-progress.

4 Kathryn Yusoff, *A Billion Black Anthropocenes or None,* Minneapolis: University of Minnesota Press, 2019, p. 46. Emphasis our own.

5 danah boyd and Kate Crawford, 'Six Provocations for Big Data', A Decade in Internet Time: Symposium on the Dynamics of the Internet and Society, September 2011. Available at SSRN: https://ssrn.com/abstract=1926431.

6 bell hooks, *Feminist Theory from Margin to Center,* Boston: South End Press, 1984, p. 110.

movements such as 'women in tech' or 'women in STEM', are unfortunately still critically necessary today. However, we point out that while critiques of 'add women and stir' approaches have been leveraged for quite some time, they seem to continue to dominate popular discourse. Beyond 'adding and stirring', it is necessary to restructure the way labs work, and to consider and address pressing feminist concerns within them, such as those of access, epistemology, care, hierarchy, labor, and the environment.

1. Access is Complex.

Our first provocation deals with the core feminist concern of access, addressing questions such as: Who has access to the financial and spatial/infrastructural resources needed to create a lab in the first place? Who has access to an already-existing lab? Who may access a lab's resources? Who has access to a lab's outputs?

While it might be tempting to simply answer 'everyone should have access' to the above questions, 'everyone' too easily glosses over the realities of privilege, especially in higher education, which determine who can even contemplate the possibility of running a lab. It may be obvious, but also bears underscoring, that marginalized peoples must overcome countless hurdles before they can even find themselves employed by an institution of higher education. They must then position themselves to administrators and granting agencies as having the ability to successfully start a lab by doing work that is clearly legible to those in power, and is particularly legible in terms of requiring a significant investment of space, funding, and materials. Individuals must also demonstrate that they will produce outputs that are legible as 'scholarship' in their home discipline; thus, work that is, for example, collaborative, undertaken with a flat hierarchy, interdisciplinary through and through, open-ended, processual, not easily amenable to peer review, or multimodal will likely not be legible those with the power to fund them, whereas work that is, for example, heavily data or technology-driven, undertaken with a clear hierarchy (such as a principal investigator moving down to numerous subordinate investigators), peer-reviewed, and publishable as a book or journal article almost certainly gives credibility.

In terms of who has access to an already-existing lab and its resources, again, it might be tempting to answer 'everyone is welcome to use a lab'. However, 'everyone' can too easily appear neutral, while the term is in fact still deeply embedded in ableist, gendered, colonial and racial assumptions about who counts as a someone, especially a someone of value. We explore these sorts of epistemic assumptions in our second provocation below, but for now we can assert that, when it comes to answering the question of access to a lab, we believe in the productivity of continually questioning, answering, and questioning again who gets to enter a lab, who gets to use its materials, and who gets to produce work considered 'of value'. Such probes can be broken down further into questions including, but not limited to: Is the entrance to the space, as well as the interior, and signage accessible to people with disabilities? Are there clear instructions about how to use the equipment, or are there unwritten/unspoken assumptions about expertise that will determine who will or will not use it? What kinds of opportunities are there for people to receive training on how to use the equipment? If all the equipment is not immediately available in the lab, is there an up-to-date and easily discovered inventory?

Finally, with regards to who has access to a lab's outputs, once more we advocate for a practice of continual questioning. Such questions include, but are not limited to: Is the output produced in accordance with accessibility standards? Is it open-source (including open-hardware, open-data, etc), and if not, why? Is the output written in clear and accessible language, and/or supplemented with images, infographics, audio, video, or other materials to accommodate multiple audiences and learning styles?

It should go without saying that while continually questioning, answering, and questioning again who has access to a lab and its materials is necessary, the questions and answers in and of themselves will not change the demographic of who is accessing the lab. Going out into communities around the lab to find out who might have an interest in participating, and what particular practices need to change to better welcome those potential participants, is also required. That is, lab members need to make sure that in thinking through lab access they don't simply capitulate to an iterative process that only takes into account who and what is already known.

2. Epistemic Assumptions Run Deep.

Our second provocation deals with the epistemic underpinnings of labs. As we have already indicated, the history of labs is inseparable from the history of science, with the anatomical theatre, apothecary, and Edison's lab serving as a few early examples. We have also noted that science is a project with colonial origins. As Tuhiwai Smith notes, scientific classification systems were developed largely as mechanisms for organizing the knowledge generated by (and appropriated from) expeditions to the 'new world': 'New colonies were the laboratories of western science'.[7] Making this history explicit is the first step to demonstrating how contemporary labs may, advertently or inadvertently, be bound to knowledge and value systems adopted from empirical science. Writing alternative histories of labs back in, by documenting the shift of kitchens between lab and not lab for instance, is also a valuable concurrent exercise. Together, these kinds of correctives can help to illuminate how marginalized knowledges have been excluded in the scientific codification of knowledge within labs, and more generally.

As Geri L. Dickson reminds us, 'scientific knowledge does not represent the totality of knowledge', and historical approaches are incomplete if labs do not think through their inherited assumptions and reorient themselves where necessary.[8] The work again begins with the inclusion of diverse persons and perspectives within lab leadership, membership, and the communities the lab interfaces with. Lab communities include the local community in which a lab is situated, the communities who will be impacted by a lab's work, and communities that the lab researches, where applicable – all of which must be considered a vital part of a lab's knowledge base. Reaching out to community representatives, building long-term

7 Linda Tuhiwai Smith, *Decolonizing Methodologies: Research and Indigenous Peoples*, London: Zed Books, 2012, p. 68.

8 Geri L. Dickson, 'Metaphors of Menopause: The Metalanguage of Menopause Research', in Alison Jaggar (ed.) *Just Methods: An Interdisciplinary Feminist Reader*, 2nd edition, Boulder: Paradigm Publishers, 2014, p.157.

relationships with them (as opposed to one-time 'outreach' events), sharing lab outputs with them in an accessible fashion, and being open to their feedback (as a form of peer review) are therefore significant strategies for feminist lab-making. Some methods for working with a lab's communities can be adapted from Patricia Maguire's 'Feminist Participatory Research', which, via Tandon, 'begins with the premise that knowledge has become the single most important basis of power and control'. Maguire continues:

> Ordinary people are rarely considered knowledgeable, in the scientific sense, or capable of knowing their own reality. They are excluded from the increasingly more specialized research industry, barred by requirements of the 'scientific method', and by intimidating concepts and jargon, money, time, skills, and experience.[9]

Maguire's list of how non-specialists are excluded from knowledge-making practices can be reversed into a set of counter-methods for labs, again tying back to access – for example, by making language, tools, and skills accessible for participation of community members and other non-experts.

Other forms of knowledge production which are of particular importance in lab settings are embodied knowledges and skills. Knowledges such as tool making and repair, craft, and other bodily doings cut across a range of lab disciplines, from makerspaces to biolabs. How are these knowledges included as part of the lab's knowledge base? How are they documented and acknowledged? At the same time, technical skills are sometimes treated as *more* valuable, particularly in technology-centered spaces. 'Soft skills' such as communication, organization, management, writing, mediation, and knowledge-synthesis must also be taken into consideration. How are these valued as part of the knowledge work of a lab?

Finally, situating a lab's research is critical for feminist work. This includes reflexivity about a lab's position and perspectives, transparency about funding and research stakeholders, as well as efforts to complicate notions of objectivity whenever possible. Feminist researchers have repeatedly demonstrated the impossibility of a neutral 'view from nowhere', as even the most mundane research activities are knotted in subjectivity. Feminist labs should therefore work towards, as Haraway argues, 'partiality and not universality [as] the condition of being heard to make rational knowledge claims'.[10]

3. Labs are Laborious.

In this provocation, we shift from considering who counts as a knower to who counts as a laborer in a lab. What labor counts? How is labor equitably acknowledged and compensated? How are attributions handled? How is rest ensured?

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9 Patricia Maguire, 'Feminist Participatory Research', in Alison Jaggar (ed.) *Just Methods: An Interdisciplinary Feminist Reader*, 2nd edition, Boulder: Paradigm Publishers, 2014, p. 420.

10 Donna Haraway, 'Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective', *Feminist Studies* 14, no. 3 (1988): p. 350.

The etymological root of 'laboratory' is the latin 'laborum' and 'laboratorium', for labor and place of labor, indicating the degree to which embodied labor has historically been at the heart of any lab work.[11] However, too often labs continue to be structured hierarchically in such a way that those performing the embodied labor of experimentation and testing are given titles such as 'technician', 'intern', or 'research assistant', compensated with lower (or no) pay, and left unattributed on lab outputs or listed at the end of a long list of authors while those perceived to be performing the intellectual direction of the lab are placed at the top, with all of its attendant privileges. A lab driven by feminist ethics must aim to acknowledge the labor of all of its workers. This may include not only those laborers carrying out duties more directly tied to research, but also those working in service of the lab and performing less legible labor such as the cleaning staff, administrative staff, and marketing staff.

In terms of author attribution, some labs may choose to address unjust hierarchical assumptions by opting for a mostly flat model. To take just one example, they might choose to place an asterisk next to all or some author names, indicating that those authors contributed equally. These models are excellent in some cases. However, as Liboiron et al. point out, non-hierarchical attribution can make it difficult for lab members to accrue publication value when seeking employment in academic institutions. We are particularly taken with the methods the authors put forward from their own lab – the explicitly feminist, anti-colonial Civic Laboratory for Environmental Action Research (CLEAR), methods based in 'a situated and context dependent process that assumes decisions about author order will be different for every paper'.[12] The authors concretely outline methods for consensus-building that take into consideration equity across the complex social, economic, and political locations of lab laborers. We believe that such a system could be used not only for author attribution, but for devising job titles that work to complicate hierarchies, and that suddenly make visible the entire range of laboring that takes place in a lab.

Finally, appropriate attribution of labor must be paired with equally appropriate compensation, as well as with boundaries for how much each lab member can be expected to work. Drawing on Liboiron et al.'s guidelines for attribution, we believe that the creation of clear divisions between work time and rest time should also be made via a process driven by equity (taking into account how much people are able and available to work), consensus (open discussions should be staged about equitable division of labor, weekly work hours, breaks, and holidays), and care (all work hours should contain some flexibility to account for the physical and emotional well-being, childcare requirements, and other needs of each member).

4. Hierarchies Trickle Down to Knowledge.

Expanding upon issues of hierarchy, this provocation considers how hierarchy is negotiated in the overall organization of a lab and its work. Here, we focus here on the hierarchies within lab membership itself. But it is important to note that these points, as well as the labor and

11 Karen Knorr Cetina, 'Laboratory Studies: The Cultural Approach to the Study of Science', *Handbook of Science and Technology Studies*, Thousand Oaks: Sage, 1995, p. 585.

12 Max Liboiron et al., 'How to Run a Feminist Science Lab Meeting', *CLEAR* blog.

attribution concerns addressed above, extend also to addressing hierarchies in external community relationships, as well as with any human and non-human research subjects. As we have already touched upon, distribution of power is a key concern for feminist methodology. Given that the knowledge produced in labs is collectively shaped,[13] power negotiation is particularly crucial to ensuring that the knowledge practices of a lab represent the diversity of its members. Decentralization of power might look different for each lab depending on its size, institutional commitments, and the kinds of work it produces. For example, are lab decisions made through a public or anonymous voting process? Are there elected or volunteer representatives who make decisions on behalf of member concerns? Must unanimity be reached in voting?

Here, CLEAR again serves as a useful model, as the lab has outlined protocols for running meetings and coming to agreement based on established methods of talking circles, facilitation, and consensus-based decision making.[14] Even when applying methods such as these, however, conflict will inevitably arise in democratic negotiations,[15] and how disagreements are addressed is significant for establishing affirming feminist spaces. We will address conflict further in the following section, but one helpful strategy for overcoming decision-making hurdles is by outlining (and periodically re-outlining) the lab's mission and values, then considering the decisions to be made against these values. Even seemingly mundane questions such as how a lab represents itself in marketing collateral, or which sources of funding it may or may not accept, are key to connecting a lab's work to its values, and should be considered with intention in lab meetings. The MIT Media Lab, for example, has long embraced funding from ARPA, DARPA, and large corporations;[16] and we also now know that the lab has knowingly accepted large sums of funding money from known sex trafficker Jeffrey Epstein over the years.[17] How does this reflect on the Lab's values, and how has it trickled down to its research agenda?

Establishing shared values builds community,[18] and building and maintaining community in the lab can aid in the overall work of hierarchical negotiation. Cultivating community can take many forms, such as regular check-ins or surveys that take stock of community member needs, with clear follow-ups to address those needs. Community can also be addressed in more unstructured ways, such as by encouraging and supporting social time. Some feminist labs, such as Laura Devendorf's Unstable Design Lab, offer open 'playtime', where lab members can informally talk and experiment. This kind of space for connecting knowledge-making work with

13 See Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts*, Princeton: Princeton University Press, 1986. Also see Ludwik Fleck, *Genesis and Development of Scientific Fact*, Chicago: University of Chicago Press, 1981 (1935).

14 Liboiron et al.

15 Iris Marion Young, *Inclusion and Democracy*, Oxford: Oxford University Press, 2000.

16 Wershler et al., unpaginated.

17 Ronan Farrow, 'How an Elite University Research Center Concealed its Relationship with Jeffrey Epstein', *The New Yorker*, 6 September 2019, https://www.newyorker.com/news/news-desk/how-an-elite-university-research-center-concealed-its-relationship-with-jeffrey-epstein

18 Laurie Fuller and Ann Russo, 'Feminist Pedagogy: Building Community Accountability', *Feminist Teacher* 26, no. 2-3 (2016): p. 179.

dialogue and 'lived histories' is useful for feminist community-building, as well as for feminist knowledge-production, as Jacqueline Wernimont and Elizabeth Losh argue in their discussion of feminist makerspaces: 'We do not separate "yack" from "hack" any more than one might partition a "stitch-n-bitch"'.[19] It is important to stress here, however, that even informal social activities can reinforce hierarchies, as in Edison's lab, where community-building was more akin to 'male bonding' according to Wershler et al., 'in a way that very much anticipates contemporary tech/startup culture.'[20]

5. Safety Includes Affirmation.

This provocation emerges from questions about how to make a lab physically and emotionally safe, as well as what safety means. How is the lab made into an affirming space for members, visitors, and its extended community? Where can lab members turn for support?

Regardless of whether a lab is a digital humanities lab, media lab, wet lab, dry lab, hacklab, fablab, or makerspace, it must be physically safe. A lab is, as Wershler et al. assert, 'a complex assemblage of relational forces between its space, infrastructure, apparatus, techniques, and people'.[21] Inattention to any one of these elements – in the case of safety, an inattention to people – creates a power imbalance not only between those who are safe (for example, directors or administrators who might have little direct contact with lab equipment) and those who are not safe (those who do have contact in the course of undertaking experiments or creative work), but it also creates a power imbalance between a lab's space and equipment and the people working there. What good is a lab if its materials are valued more than its human participants? Thus, in terms of physical safety, labs must regularly take stock of their exterior and interior infrastructure. Is the lab's electrical wiring up to its needs? Does it have adequate ventilation and clear information and procedures about hazardous materials and their disposal? Is it secure from intruders? Does the lab have a system in place for reporting and addressing malfunctioning equipment?

Looking after the emotional well-being of lab participants is also critical, and begins by respecting their identities and needs. Asking all lab community members to share their gender pronouns should be standard practice as new members join. There should also be a forum for members to note accommodations they might require in the lab, as well as religious observances or other commitments that might affect their work schedule. Appropriate, clear protocols for incorporating these needs into the lab's structure must then be established. Care for lab participants is also grounded in the constant and careful maintenance of the lab as an affirming space. What we intend here, after Jeannie Ludlow, is for the lab to go beyond notions of 'safe space' in order to build an environment that is supportive for growth. As we mentioned earlier, conflict and disagreement is inevitable in labs, and as Ludlow asserts,

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19 Jacqueline Wernimont and Elizabeth M. Losh, 'Wear and Care Feminisms at a Long Maker Table', *The Routledge Companion to Media Studies and Digital Humanities*, 2018, p. 100. Note for non-English speakers, 'yack' refers to light, conversational talking.

20 Andre J. Millard, *Edison and the Business of Innovation*, Baltimore: Johns Hopkins University Press, 1990, p. 23.

21 Wershler et al., unpaginated.

feminist spaces are not always 'safe', in the sense that they challenge viewpoints and raise sensitive topics. Ludlow argues instead for what she calls 'contested spaces', ones that are not conflict-free but rather support respectful disagreement and tension.[22] Cultivating the lab as a contested, affirming space, is key for supporting productive conflict-resolution and community-building. Emotional and physical safety must also be nurtured via a clear and transparent reporting structure for breaches in professional behavior. A lack of transparency about what happens in a lab, what constitutes professional behavior, and who may report to whom can quickly produce an environment where abuses of power take place.

6. Non-Humans are Community Members, too.

In this final provocation, we point to the more-than-human concerns that a feminist lab must take up. As we have already mentioned above, labs and lab practices emerged out of scientific value systems – systems which imposed worldviews onto knowledge production that were limited in scope. Robin Wall Kimmerer highlights those limits in *Braiding Sweetgrass,* and she makes clear how anti-colonial, feminist approaches can serve to bring neglected concerns back into view, specifically, those of non-humans. She writes:

> In moving from a childhood in the woods to the university, I had unknowingly shifted between worldviews, from a natural history of experience, in which I knew plants as teachers and companions to whom I was linked with mutual responsibility, into the realm of science. The questions scientists raised were not 'Who are you?' but 'What is it?' No one asked plants 'What can you tell us?' The primary question was 'How does it work?'[23]

We insist that all living beings impacted by a lab's work should be considered as part of its community. When a lab works with non-human subjects, ethical questions are readily noticeable; however, we would like to point out that non-humans outside of the lab also require care. How are the needs of our non-human planetary cohabitants taken into consideration in the lab's work? How are ethical material usage and disposal taken into account (practices which can of course also affect human animals, with marginalized groups disproportionately affected)?[24] One example that is alarmingly prevalent in labs is the use of plastics. Plastics are found widely across lab disciplines – from the test tubes of biolabs to the circuit boards of hackerspaces. These implicate a lab in the systemic extraction and waste practices currently affecting all of Earth's living beings.

In order to address questions of material usage and waste, we propose Amanda Starling Gould's 'Digital Environmental Media Studies (DEMS)' framework as a useful starting point to think with.[25] While the framework is built around the digital, it can be applied to other

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22 Jeannie Ludlow, 'From Safe Space to Contested Space in the Feminist Classroom', *Transformations: The Journal of Inclusive Scholarship and Pedagogy* 15, no. 1 (2004): pp. 40-56.

23 Robin Wall Kimmerer, *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants*, Minneapolis: Milkweed Editions, 2013, p. 49.

24 'Pollution Affects Americans Unequally: Interview with Robert Bullard', Union of Concerned Scientists, *Catalyst* (Spring 2017), https://www.ucsusa.org/sp17-inquiry-robert-bullard.

25 Amanda S. Gould, 'Restor(y)ing the Ground: Digital Environmental Media Studies', *Networking Knowledge: Journal of the MeCCSA Postgraduate Network*, 9.5 (5 July 2016).

knowledge practices, as it encourages taking the full supply chain of sites of knowledge-making into consideration, from beginning (such as minerals and plastics) to end (such as wastes and toxicants). Reuse, repair, and other 'circular economy' practices are, as Isenhour and Reno make evident, firmly tied to a feminist ethics of care,[26] and are of vital importance to a feminist lab's work.

From Feminist Labs to Feminist Logistics

The provocations we have outlined here consider how models of thinking-together could benefit from the application of feminist methodologies and approaches. While we have written them for feminist labs, they can also be applied towards broader feminist logistics. How can human and non-humans, together with technologies, spaces, and infrastructures, be organized into collective feminist sites? To be clear, attending to these concerns can be time-consuming, tedious, and perhaps worst of all – boring. Here we find useful Astra Taylor's call for doing the laborious work of organizing, arguing that 'endless meetings, strategy sessions, research, spreadsheets, [and] conference calls' are invaluable efforts in social justice work.[27] We believe these to be equally important for spaces of feminist knowledge-making and logistics.

We have also implicitly argued here for making lab practices and logistics *visible,* and thereby accountable, to those who have been and continue to be written out of labs. However, as we insist throughout, it is not simply a matter of diverse representation. While crucially important, this cannot, in and of itself, cure deeply embedded patriarchal, colonial, racist, ableist, imperialist, ageist, and environmentally damaging assumptions. Rather, those assumptions themselves must be addressed, as they are intrinsically tied to the infrastructure and administration of that crucial engine of knowledge production: the lab. Questions such as what counts as expertise and who counts as an expert (in the words of Latour and Woolgar, an issue of 'credit and credibility')[28] remain of vital importance. Thus, by way of the preceding six provocations, we end with a final challenge. What might be possible if we rethink not just the who and what of labs, but the how?

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26 Cindy Isenhour and Joshua Reno, 'On Materiality and Meaning: Ethnographic Engagements with Reuse, Repair & Care', *Worldwide Waste: Journal of Interdisciplinary Studies*, 2.1 (2019).

27 Astra Taylor, 'Keynote', *Rhizome Seven on Seven,* New York, 2016, https://rhizome.org/editorial/2016/may/14/seven-on-seven-2016.

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Making It Up: Critical Practices of Instituting

Bernhard Garnicnig

MAKING IT UP: CRITICAL PRACTICES OF INSTITUTING

BERNHARD GARNICNIG

This text exists because of the proximity between the terms 'critical making' and 'making it up'. The text examines cases in which artists 'made up' spaces and places that take on institutional and corporate forms. In these cases, this making-up is understood as an emancipatory appropriation that actualizes artists and citizens relations to institutions or corporations. Copying and mimicking the heraldry, ornament, and jargon of institutions is considered as a means towards reaching an eye-level position with corporations or bodies of governance in order to address them with the intent of political transformation. The following examples allow us to reflect on each of their distinct approaches to the understanding of 'criticality'. These allow reflection on how such inventive mimicry might need to be approached. Rather than attempting utopian improvements, this practice of making spaces coproduces the slippages that occur once infrastructures attempt to adopt and dissolve their difference.

Meeting a Bootstrap Museum Director

I met David H. Wilson, the founder of the Museum of Jurassic Technology, in their upstairs tea room. Just minutes earlier I had finished watching a film in their screening room, a portrait of the Isabella Stewart Gardner Museum in Boston. The film was shot with the idea of portraying the museum through its maintenance personnel, as well as emphasizing the invisible relations between objects around which its founder had arranged the exhibit. David was very fond of this museum and mentioned it as if it were a sister from a different mother, with both siblings sharing a profound love for museums and the poetic power of constellations.

I inquired into how his museum got started and the practicalities of running it today. He proudly pointed out that everyone who worked with him could earn three times as much elsewhere, yet many of his employees have stayed on the team for years. In that moment, an employee needed Mr. Wilson's attention. Once again, the rain in this unusually wet winter had surprised the homeless man who dwells in their unused entrance to the expansion building. A brief exchange followed, centered on a soggy sleeping bag. Who owed whom how many dollars from the last time it was brought to the coin laundry to dry, and had a new one been purchased for him? The conversation became a logistical one, as often happens in environments where a lot of small things get done quickly to achieve something big. Who is going to get him a new and dry sleeping bag, and where will they try to dry the old one? In that moment, it quickly became clear that the MJT had become much more than a made-up museum. It had become a space that takes on an institutional function, integrating methods and practices critical to their time and location. Amongst other things, this allows them to create desirable working conditions that their community decides – through persistent investment of their time and talent – to be the right thing. These conditions prove to be non-threatening and desirable beyond that organization.

After the conversation with David, Hana, the administrative director and archivist, led me outside through a fire escape back door, onwards between two Airstream trailers, and into a space that houses a workshop, office, and eclectic archive. She pointed out many articles and stories that

had been written about the museum. I, in turn, presented the haul of books I got at the museum gift shop earlier. Amongst them was the book that vastly increased the mark of the Museum of Jurassic Technology's on the map of American legendary places, *Mr. Wilson's Cabinet of Wonders* by Lawrence Weschler, a finalist for the Pulitzer Prize for General Non-Fiction in 1996. It only took a few seconds to understand that the book wasn't exactly a source of pride at the museum. The book, it seemed, had tried to disentangle threads that the museum had carefully woven to enchant. Trained (and very successful) as a journalist, the author attempted to describe a kind of truth behind the museum and its founder based on his research of facts and data, an investigatory truth. This truth meticulously described a process of following clues in the museum back to their origin, hoping to discover their 'true' nature. Yet what if this attempt was misplaced? Why would it be? Perhaps the MJT does not attempt to preserve a particular kind of scientific knowledge embodied in artifacts, but a different way of knowing in which constellations of objects tell stories and create experiences of wonder. It is a different kind of epistemic machine in a way, an intentional escape from a museum as collection of facts to a museum as constellations of fabulations. In this space, truth goes beyond data, moving towards an experience of the relations between. Therefore, no truth can be captured by accounting for each bit that configures the museum, for dissecting each event that led its founder to create it.

I do not mention the Museum of Jurassic Technology because it bears the word 'technology' in its title. It might as well be the 'Museum of Pleistocene Gastronomy'. The focus here is on the building, making, and instituting of a place to which people come to work – and that work being emancipatory when compared with conditions found elsewhere in the industry. It is a space that critically prefigures practices that do not delineate and render community as a tactical asset of technology. It is a space where emancipatory practice is encoded as desire in Critical Making. In this poetic constellation of artifacts – but also in the industry surrounding it – the appearance of any 'natural order' is destroyed.[1] Making up a museum is making up the conditions under which a museum works. Those conditions are a critically personal re-rendering of what a museum is and could be. The result, in this case, is Mr. Wilsons and his team's Museum of Jurassic Technology.

Imitation and Action: The Museum of Natural History

Natural History Museums exist all around the world. As places of eco-Enlightenment pedagogy, they have been reframed to tell 'our' stories of 'our' planet. Their collections contain historic objects that are supposed to evoke the story of their times in the continuum of histories. The storytellers are minerals and fossils, skeletons and butterfly wings, vases and spearheads, garments and suits of armor – all animated by guides and mediators. These objects live in a space of the institution that governs these stories. There, the invisible arrangements that hold institutions together also control which objects are allowed to tell which stories. Alongside these historic artifacts, politicians, scientists, and donors all add their own spin to these narratives.

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1 This is referring to Mark Fisher who said: 'Emancipatory politics must always destroy the appearance of a "natural order", must reveal what is presented as necessary and inevitable to be a mere contingency, just as it must make what was previously deemed to be impossible seem attainable'. Mark Fisher, *Capitalist Realism: Is There No Alternative?,* London: Zero Books, 2009.

The Natural History Museum is also a multiple. Museums of colonial-aristocratic origin with similar names exist all around the world, names varying with local language, but all offering features similar to each other in their specificity. Like Biennials and Galleries, they can be considered readymade forms to be used and adapted, nonspatial sites replicable and available for occupation, histories to attach to, canons to disrupt or continue. The Museum of Natural History is a way to address natural orders. As an emancipatory practice, museums are material which is ripe for cooption by industrialists, but also for manipulation by artists and activists.

For a while in the year 2014, there were two Natural History Museums in New York. The first was located at Central Park West at 79th Street in the borough of Manhattan. The American Natural History Museum is a monumental classicist building, structured into several wings housing specific collections, one of which is the 'David H. Koch Dinosaur Wing'. It is named after the Mr. Koch whose conglomerate of corporations was at one point responsible for more than 50% of greenhouse gas emissions in the USA, the Mr. Koch who might fund political groups that deny climate change or the theory of evolution, the same Mr. Koch who is so fascinated with dinosaurs that he not only funded the Dinosaur wing in New York with multimillion-dollar contributions, but also a similar section at the Natural History Museum of Washington.

The other Natural History Museum in New York existed for a brief period in the summer of 2014. Motivated by the observation that a climate denier is on the board of an institution that is supposed to teach us about the preservation of the environment, a group of activists applied for funding, designed a logo, had green hats embroidered with it, painted it on banners, and printed it on their tour bus. They instituted an alternative Natural History Museum at the Queens Museum over the span of several months. It featured discussions of institutional critique and offered narrated bus tours through the natural habitat of the city, where instead of pointing out bird species, the script would focus on the 'insidious entanglement of institutions and corporations' – with Exhibit A being the Koch brothers entanglement with the Natural History Museum. Koch resigned amid controversy in December 2015, after 150 of the world's top scientists (including several Nobel laureates) and more than 550,000 members of the public joined forces to urge New York's American Museum of Natural History to kick climate denier David Koch off its board.

I interviewed Steve Lyons and Jason Jones of Not an Alternative and asked them how practices which institute / are aware of their power to institute could be taught in schools that educate artists and makers. They said the following:

> The NHM came out of a wager that we could split the museum sector by leveraging institutional legitimacy against it, that we would gain more power and influence within the museum sector by speaking as insiders than by banging on the doors as activists. Of course, the threat of 'institutionalization' is real – if by that you mean the capture and neutralization of dissent. Every insurgency is met with counter-insurgencies. Every actual threat will face the force of power. The longer we last, the more symbolic power we gain, the higher the stakes in the struggle. The smash-and-grab interventionism of the past few decades made for good

> images and great anecdotes. But the struggle for power won't be won overnight. It takes persistence. The kind of insurgency we're engaged in can only work when the insurgents set concrete but escalating objectives and unwaveringly commit to the plan, the cause, and the horizon.[2]

Commit to the horizon and foster a shared imagination, their statement suggests, but never demand that the horizon has to be set in stone. It only has to guide a process of making a community and making-public. The horizon might be an ideal, but the cause is concrete: a critical emancipatory practice of liberating institutionalism from its occupation by calcified power.

Graduates of art schools, curatorial programs, and technology degrees face a similar choice today to the artists who instituted the MJT and the NHM. Will they, with their own talent and productivity, subsidize the art market, the cultural industry, or the technology sector? Or will they instead invest in the creation of communal spaces in which the spirit and energies of 'socially engaged creative professionals and citizens of the postdigital age'[3] are not cut off by the reductive realities prescribed by institutional normative structures? Such critical making-up of spaces and places for study are now being established, offering an alternative to the degree mills backed by the technological-industrial sector.

Cautionary Tale of Occupational Utopias

Throughout my research, I keep coming back to this thought that Claire Pentecost shared in a conversation on the articulation of utopian ideas:

> Utopianism is something in our heads, it's really in all of our heads but we're not really aware of it, but it is what gets us up in the morning and we're spending our efforts on. And the problem is that if you don't start to articulate your own idea of utopia you are servicing someone else's. Most of us are servicing a neoliberal utopia unless we are consciously trying to create other kinds of communities and value systems. It is like a horizon – and I'm not talking about Utopia that you actually build and police, those get a very bad name.[4]

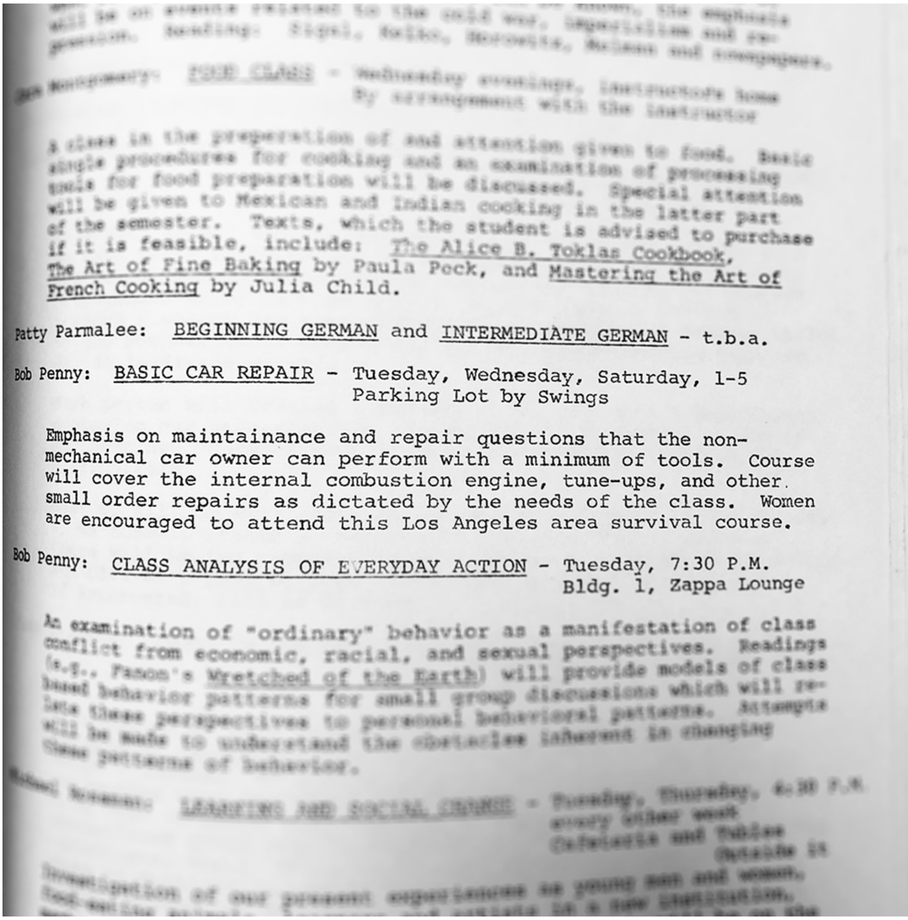
This 'getting up in the morning and spending our efforts on' resonates with my interest in *instituting* as creative practice. Utopias as horizons – as distant and receding as they seem – are points of orientation for a critical practice of daily life, or ways of life. Making it up as building and instituting might also require an emancipated unlearning of what criticality means in order to emancipate critical practice from 'someone else's' utopias.

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2 Steve Lyons, Jason Jones, and Bernhard Garnicnig, 'The Occupation of Institutionality and Institutional Liberation – Interview with Not An Alternative.' *Continent.* 7:1 (2017): pp. 74-81.

3 'Call for Contributions: The Critical Makers Reader'. *Institute of Network Cultures,* 31 October 2018, https://networkcultures.org/blog/2018/10/31/call-for-contributions-the-critical-makers-reader/.

4 Claire Pentecost and John Tresch, 'Interview with John Tresch and Claire Pentecost', in Lital Khaikin and Bernhard Garnicnig (eds) *continent* 6.3: The Technosphere Dialogues II, 2017.



A class in the preparation of and attention given to food. Basic simple procedures for cooking and an examination of processing tools for food preparation will be discussed. Special attention will be given to Mexican and Indian cooking in the latter part of the semester. Texts, which the student is advised to purchase if it is feasible, include: The Alice B. Toklas Cookbook, The Art of Fine Baking by Paula Peck, and Mastering the Art of French Cooking by Julia Child.

Patty Parmalee: BEGINNING GERMAN and INTERMEDIATE GERMAN - t.b.a.

Bob Penny: BASIC CAR REPAIR - Tuesday, Wednesday, Saturday, 1-5
Parking Lot by Swings

Emphasis on maintainance and repair questions that the non-mechanical car owner can perform with a minimum of tools. Course will cover the internal combustion engine, tune-ups, and other small order repairs as dictated by the needs of the class. Women are encouraged to attend this Los Angeles area survival course.

Bob Penny: CLASS ANALYSIS OF EVERYDAY ACTION - Tuesday, 7:30 P.M.
Bldg. 1, Zappa Lounge

An examination of "ordinary" behavior as a manifestation of class conflict from economic, racial, and sexual perspectives. Readings (e.g., Fanon's Wretched of the Earth) will provide models of class based behavior patterns for small group discussions which will relate these perspectives to personal behavioral patterns. Attempts will be made to understand the obstacles inherent in changing these patterns of behavior.

Fig. 1. Excerpt from the School of Critical Studies course schedule 1970-71.[5]

During a recent visit to CalArts, I had the chance to look at its archives, which documented the foundation years of this Disney Corporation-endowed private art school. From the very beginning, one of the newly instituted departments became a space where conceptual radical art practice and emancipatory radical pedagogy converged: the School of Critical Studies. It was an attempt to transmutate the perspective of Frankfurt School Cultural Critique to the Millenarianism of 1970s California. What can artists learn by applying a critical perspective on the social order? And from that, what do artists need to know in order to develop a practice that actualizes the demands of the time? What is the kernel they could not do without, the one thing that would give their practice relevance and the ability to reform life beyond the campus?

5 Reprinted with permission of California Institute of the Arts Institute Archives, School of Critical Studies Records.

When I found the above paragraph in the School of Critical Studies course schedule 1970-71, it made me wonder: had Bob Penny taught car repair as a critical-making skill for surviving the Los Angeles area as an artist? Is the denoted specific invitation of women to be read as an emancipatory gesture, or was 'Basic Car Repair' less mechanical than its course description suggests, and much more an analysis of societal-institutional mechanics set on the vast CalArts parking lot? As discussion of Critical Making must shed of its connection with paradigms of innovation and production, and instead re-institute spaces for discourse and action in maintenance and repair, this excerpt puts into words the utopianism that the School of Critical Studies at CalArts offered in its early days – a generous ambiguity between radical pedagogical and critical artistic practice.

Judith Adler's study of that time and place in *Artists in Offices* offers a deeper reflection on the schism between how institutions speak and how institutions think. I can only offer brief glimpses into her 'dream analysis' of this California counterculture project. Based on fieldwork between 1970 and 1972 , *Artists in Offices* provides a case study of one group of artists who responded to the changes taking place in their occupations by attempting to institute a utopian art academy where artists and pedagogues began to realize an 'Occupational Utopia'.

Seeking to outline a reason why artists would come to work in offices and bring along a strong sense of Millenarianism and Communitarianism, Adler suggests that 'dissatisfaction with existing institutions in the absence of faith in their reform' has led to a 'relief in a comforting conviction' that these existing and dissatisfying institutions are results of a 'doomed past' and that 'until the future has been consolidated, life can be passed in an alternative system'. Through this lens, the free universities and tent cities served as escapist 'retreats for tired refugees and – in the end – as testing grounds for later superficial innovation in the dominant institutions they meant to replace'.[6]

This approach to instituting an occupational utopia at CalArts might be what Claire was talking about in our interview. Once these pedagogical utopias become too real, too much effort is put into realizing an ideal. They begin to fail their own aspirations. As exciting as the scene at CalArts must have been in those years, perhaps the students and faculty were actually invited to join the realization of someone else's utopia. Practices of critical making-things-up require liberation from the Utopias which inform our preoccupations with our own occupations.

The school had a short-lived history. All too soon, it became clear to Adler that those seeking to institute an avant-garde school and to maintain its credibility 'would find themselves inevitably confronted with contradictions between the institutional imperatives of a school and the symbolic imperatives of the avant-garde tradition they claim to continue and cite as the source of their legitimacy'.[7] As Adler's study details, the original program was halted for reasons deeply entangled with the transformation of the school's governance structure . At that moment, it was crucial for the first beginning to be over and for a new one to begin. The result, after several iterations, is the School of Critical Studies as it exists today.

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6 Judith Adler, *Artists in Offices: An Ethnography of an Academic Art Scene*. New Brunswick, NJ: Transaction Books, 2003, p. 24.

7 Adler, *Artists in Offices*, p. 45.

Outro

I wrote some of this text at my desk in an applied sciences school that hosts my research project. Not too long ago, this place was someone's idea, an idea involving someone's agenda, with someone's belief in serving the state, motivated by someone's hope for a better future for some next generation, limited by someone's epistemological limits and ways of life. I am sitting in a place that was once made up, conceived by a commission on paper, but that now services me with infrastructures, endows and obliges me with power, and offers free and good coffee. Perhaps, as you are reading this, you are in a similar space or are on your way to one or from there. Once this train of thought has begun – that everything was someone's idea at some point – one could think that everything is made up in some way, that we are all experiencing a kind of constructivist make-belief. We've grown skeptical of the sometimes destructive habit of creativity that we developed in our brief time on this planet. The power to create more things, more frequently, no longer feels right. Aren't there things and places that grow into being without our heavy heart and clumsy hands? Perhaps destructive, but nonetheless necessary, is the practice of emancipatory politics that attempts to dissolve everything that makes itself appear as a natural order while being artificial, such as institutions established by previous collective demands for a better life. Today, thousands of homeless people evicted by the tech bubble need to make the asphalt of San Francisco their home. Simultaneously, coding camps invite urban transitory people to integrate themselves into gainful employment, programs backed by the very same sector that is causing their eviction. The natural order of things – between the haves and have nots, between those in-the-know and those who know-to-get-through, between the makers and won't-make-its – is rendered awfully naturalistic, if one dares to actually look and listen. What is it that is critical at this time to make up?

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Appendix 1:

Critical Making Bibliography - Critical Mapping Sources

Verena Kuni

APPENDIX: CRITICAL MAKING BIBLIOGRAPHY - CRITICAL MAPPING SOURCES

VERENA KUNI

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AUTHOR BIOGRAPHIES

Jamie Allen investigates what technologies teach us about who we are as individuals, cultures, and societies. He has been an electronics engineer, a polymer chemist, and an exhibition designer. He likes to make things with his head and hands – experiments into the material systems of media, electricity, and information as artworks, events, and writing. He attempts to recompose the institutions he works with in ways that assert the importance of generosity, friendship, passion, and love in knowledge practices like art and research.

Viktor Bedö (PhD) is researcher at the Institute of Experimental Design and Media Cultures at the University of Applied Sciences and Arts Northwestern Switzerland and visiting research fellow at the Centre for Urban and Community Research at Goldsmiths University London. He is founder of Tacit Dimension, an independent research lab for street games.

Loes Bogers works as a researcher at the Visual Methodologies Collective based at the Amsterdam University of Applied Sciences, where she also coordinates and teaches the interdisciplinary semester course Makers Lab: Making as Research. Loes holds a BA in Media & Cultural Studies from the University of Amsterdam and an MA in Interactive Media: Critical Theory & Practice from Goldsmiths College, London. She is the co-founder of arts-based feminist research group the Body Recovery Unit, and core member of the Hackers & Designers collective in Amsterdam.

Kat Braybrooke is a digital anthropologist, designer, and curator whose work explores the politics of digital spaces and practices – in particular the relations between hackers, makers, and social infrastructures. For her PhD with the University of Sussex Humanities Lab, she conducted an ethnography of the first collections of makerspaces in London museums.

Abigail Browning is a doctoral candidate in Communication, Rhetoric, and Digital Media at NC State University. Her research currently examines how online and physical environments feature in collective action such as crowdfunding, brand crises, and large-scale activism. Before NCSU, she earned her MFA in Creative Writing in poetry from UNC-Greensboro.

xtine burrough is a hybrid artist. She uses remix to engage networked audiences in critical participation. burrough is Professor and Area Head of Design + Creative Practice in the School of Arts, Technology, and Emerging Communication at UT Dallas, where she organizes LabSynthE, a laboratory for synthetic, electronic poetry.

Michaela Büsse is an artistic researcher interested in speculative and experimental design practices as well as philosophies of technology and ecology. Her practice is research-led, ranging from text to film and installations to workshops. Currently, Michaela is a PhD candidate at the Critical Media Lab in Basel.

Serena Cangiano (PhD) is coordinator of the MAS in Interaction Design and responsible for FabLab SUPSI in Lugano. Since 2009, she has worked on the design of educational formats, combining design and technology through prototyping. She has developed research and design projects for teaching computational thinking and established innovative programs on design for digital social innovation.

Letizia Chiappini is an urban sociologist and PhD candidate at the University of Milano Bicocca and the University of Amsterdam. Her PhD project focuses on the concept of urban platforms, investigating hyped phenomena such as the 'sharing economy' and 'maker movement' in Amsterdam and Milan. She is currently a lecturer at the University of Applied Sciences in Utrecht.

David Cole is a teacher who focuses on learning sequences and materials that call on familiar literacies and gestures found in writing, illustration, and communication to provide a foundation of confidence for exploring more and more complex possibilities.

Maria Dada is a Research Fellow in Visual Cultures at Goldsmiths University and at the Digital Anthropology Lab at UAL. Her research is situated within the fields of design and material culture. She investigates the possibilities of digital materials in reconfiguring socio-political and economic structures. A PhD candidate in science and technology studies at Durham University, she holds an MA from the Centre for Research in Modern European Philosophy, and a BSc in Computing and Communication Arts from the Lebanese American University in Beirut.

Sharon Ede is a public servant working for an Australian State government agency, where she successfully advocated for funding for community-based fabrication spaces. She has a long track record of activism and expertise in fostering sustainable, post-growth urban development and was a cofounder of the Post Growth Institute in 2010.

Lori Emerson is Associate Professor in the English Department and the Intermedia Arts, Writing, and Performance Program at the University of Colorado Boulder. She is also Director of the Media Archaeology Lab, the author of *Reading Writing Interfaces: From the Digital to the Bookbound* (University of Minnesota Press), and co-editor of numerous collections.

Gareth Foote is an educator, designer and technologist, and Course Leader for BA (Hons) User Experience Design at London College of Communication. His research and creative practice focus on the effects of networked culture, using art and design to probe opaque computational systems. He develops and facilitates courses and workshops within higher education and cultural institutions around the UK and in Europe in creative and critical applications of computation.

Bernhard Garnicnig is a researcher with 'Institutions as a Way of Life' at IXDM Basel, lecturer at Kunstuniversität Linz, co-editor of continentcontinent.cc, former Very Artistic Director at the Palais des Beaux Arts Wien, co-founder of the Bregenz Biennale and co-founder of Supergood. His dissertation project, titled 'What Artists Institute', elaborates a critical vocabulary of instituting practices.

Felix Gerloff was awarded his Masters in cultural history and theory by Humboldt University Berlin in 2013, with a thesis on the movement of netlabelism and free music on the web. His current doctoral project investigates programming as a cultural technique, computational thinking, and coding epistemologies in human-machine collaborations.

Krystin Gollihue received her PhD from the Communication, Rhetoric, and Digital Media program at NC State University, where her dissertation considered the technical making practices of farmers in the American South. She is currently a Brittain Postdoctoral Fellow at Georgia Tech, where she teaches technical communication and researches the rhetoric of rural resilience.

Anja Groten is a designer, educator, and community organiser investigating collaborative processes of design. In 2013 Anja co-founded the initiative Hackers & Designers, attempting to break down the barriers between the two fields by enforcing a common vocabulary through education, hacks, and collaboration. Since 2018 Anja is a PhD Arts candidate and researcher at the consortium 'Bridging Art, Design and Technology through Critical Making'.

Xin Gu is a Lecturer in the School of Media, Film, and Journalism at Monash University. Xin's work has featured prominently in the attempt to contextualise contemporary Western debates around cultural economy, creative cities, and cultural policy in the Chinese context. Xin's current research concerns cyber culture in China, focusing on the organization of hacker spaces and the maker industry. Her research looks at the 'democratization' of creativity through making in China's digital media industries. She is currently contracted by Routledge for a joint-authored book titled Culture and Economy in the New Shanghai.

Graham Harwood and Matsuko Yokokoji have lived and worked together since 1994 under the title of YoHa (the English translation of 'aftermath'). YoHa's graphic vision and technical tinkering have powered several celebrated collaborations, establishing an international reputation for pioneering critical arts projects.

Deanna Herst is senior research lecturer and a PhD candidate at Willem de Kooning Academy / University of Applied Sciences Rotterdam. After graduating as an art historian with a thesis on photography (MA, Utrecht University), her current interests lie in art and design in the context of technology and open design. Most recently she has been developing her dissertation on authorship in open design and participatory aesthetics, a topic that she has published and lectured on internationally.

Garnet Hertz is Canada Research Chair in Design and Media Arts and is Associate Professor in the Faculty of Design and Dynamic Media at Emily Carr University. His art and research investigates DIY culture, electronic art, and critical design practices. He has shown his work at international venues in seventeen countries, including SIGGRAPH and Ars Electronica. In 2003, he was awarded a Fulbright; in 2008, he received the Oscar Signorini Award in robotic art. His research is widely cited in both academic publications and the popular press, including *The New York Times*, *Wired*, *The Washington Post*, NPR, *USA Today*, NBC, CBS, TV Tokyo, and CNN Headline News.

Merle Ibach is a junior researcher at the Critical Media Lab as well as a PhD candidate at Leuphana University. She is interested in the notion of the ecosystem as design process and how digital environments correlate with socio-ecological transformation. Her research practice is driven by fieldwork and material-aesthetic investigations.

KairUs is a collective of two artists: Linda Kronman (Finland) and Andreas Zingerle (Austria). They explore topics such as vulnerabilities in IoT devices, corporatization of city governance in Smart Cities, and citizen-sensitive projects in which technology is used to reclaim control of our living environments. Their practice-based research is closely intertwined with their artistic production. Adopting methodologies used by anthropologists and sociologists, their artworks are often informed by archival research, participant observation, and field research. Alongside their artworks, they publish academic research papers and open access publications. These contextualise their artworks, placing them in wider discourses such has data privacy and security, activism and hacking culture, disruptive art practices, electronic waste, and the materiality of the internet.

Tom Keene is an artist, activist, and researcher who investigates the role of marginal and often obscure technological objects. He considers how technical objects mediate and construct social relations. These objects have consisted of municipal databases, wireless protocols, algorithms, electrical components, mobile devices, cloud servers, automated vacuum cleaners, and biological sensors.

Cindy Kohtala is Postdoctoral Researcher at the Department of Design, Aalto University, Finland. She has studied fab labs (mainly in northern Europe) and their sustainability efforts for more than eight years and has been involved in several urban activist initiatives. She has worked in Design-for-Sustainability research and education for twenty years.

Verena Kuni is a scholar in the field of art, cultural, and media studies and Professor of Visual Culture at Goethe University, Frankfurt Main. Her research, teaching, projects, and publications focus on transfers between material and media cultures – media of imagination and technologies of transformation at the intersections of art, science, technology, and popular culture.

Maya Livio is a PhD candidate and Instructor at University of Colorado, Curator of the annual media arts festival MediaLive at BMoCA, Curator of the Media Archaeology Lab, and a feline caregiver. Her research, cultural production, and teaching draw from a commitment to cultivating more just ways of living and dying on a networked planet.

Benjamin Matthews is a Lecturer in the School of Creative Industries at the University of Newcastle, Australia, who investigates post-industrial media work, emergent network cultures, and media art. His media industry career included agency roles and research consultancy in design planning and strategy, brand management, experience design, and creative facilitation.

Shintaro Miyazaki studied media studies, philosophy, and musicology in Basel/Berlin, and wrote his PhD on the history (1200 | 1800 | 1930-2010) of digital technologies and algorhythmics. Currently on an extended field trip in design/art, he is interested in moments of criticality which free us from exploitative relations with algorithmic infrastructures and which at the same time keep them alive and adaptive.

Wim Nijenhuis is an architect, writer, and Associate Professor Emeritus in Theory in Art. Wim's work has featured prominently in the domain of architectural theory and history, with articles and books published such as *The Diabolical Highway* (2007) and *The Riddle of the Real City* (2017). His current research concerns the theory of making in architecture and its role in architectural practice. His focus is on the concepts of creativity and matter. Under what conditions can matter be an active participant in creative processes? Currently he is finishing his book *The Response of Matter*, due to be published in 2020 by ArtEZ Press.

Paul O'Neill is an artist and researcher based in Dublin, Ireland. His interests and research relate to tactical media, hacktivism, remix culture, and media archaeology. He is currently completing a PhD in the School of Communications in Dublin City University.

Samantha Penn's practice-based research explores how the evolution of home appliances has shaped and standardized certain definitions of home and industry, gender, work, knowledge, and security. Her methods developed while studying at Goldsmiths University (Interactive Media: Critical Theory and Practice); her research feeds into the strand of Critical Technical Practice developed at Goldsmiths.

Hannah Perner-Wilson is trained as a designer. Her documentation aims to capture a material practice of electronics in the form of recipes – as descriptions-of-process rather than instructions-on-how-to.

Matt Ratto is an Associate Professor in the Faculty of Information at the University of Toronto, the Bell University Labs Chair in Human-Computer Interaction, and head hacker at the Critical Making Lab. His research examines how hands-on productive work – making – can supplement and extend critical reflection on the relations between digital technologies and society. Ratto has curated critical making events since 2007 in the UK, the Netherlands, Sweden, Scotland, Canada, and the US.

Pip Shea's work interrogates how technology shapes civic and cultural practices. Since 2010 she has been researching, organizing, and participating in makerspaces. Pip has been a director of Farset Labs, a hackerspace and technology charity in Belfast, and worked as a researcher and writer on a European Union Special Project investigating creative practices in and around fab labs in Spain, Ireland, and the UK. She has published widely on the topics of technology, innovation, and social change.

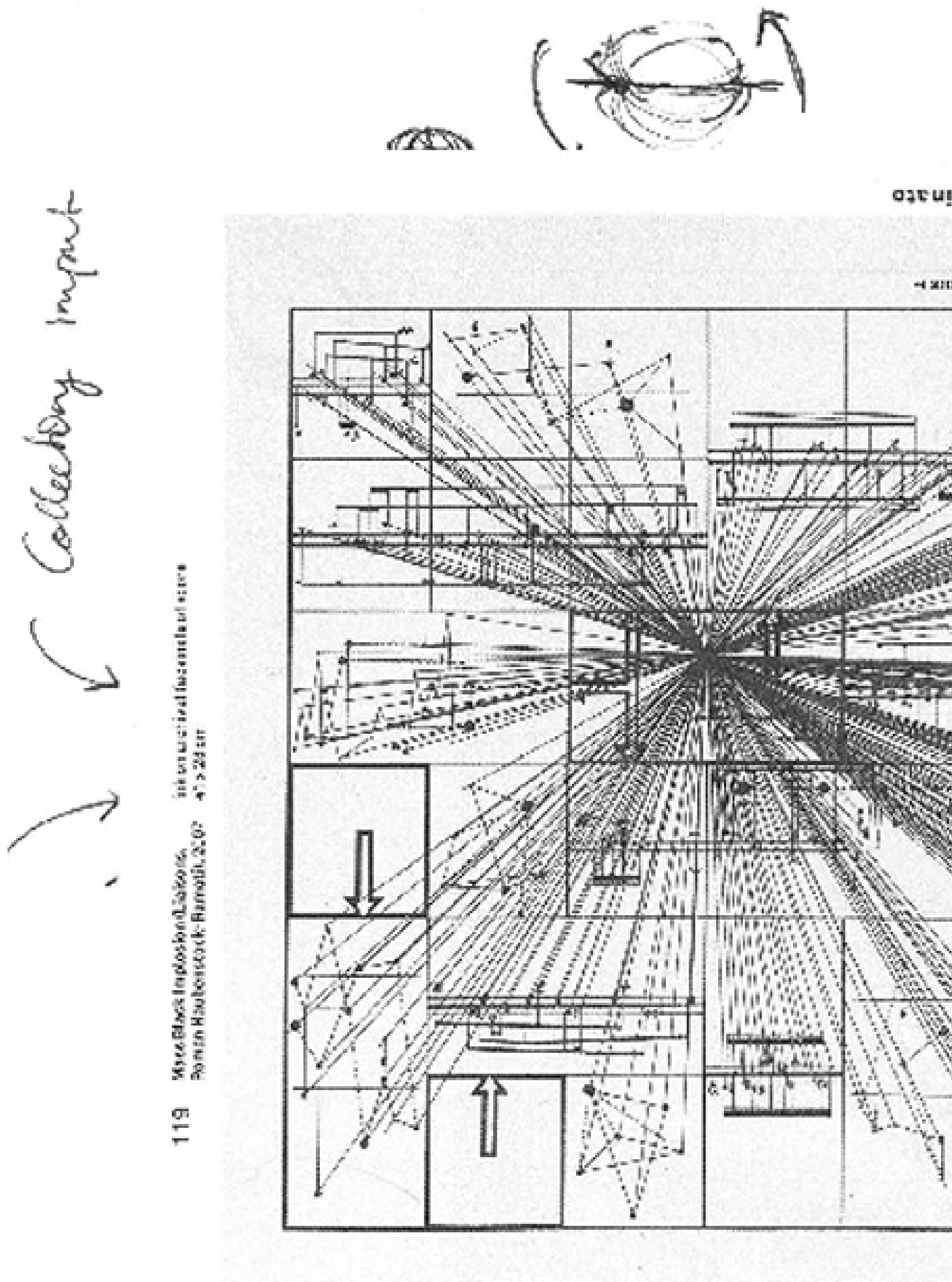
Caroline Sinders is an artist and machine learning design researcher. She has held residencies with BuzzFeed, Eyebeam, the Studio for Creative Inquiry, and the International Center of Photography, amongst others. She's currently a fellow with the Mozilla Foundation as well as the Harvard Kennedy School. Caroline's work has been featured in MoMA PS1, the Victoria and Albert Museum, the Museum of Modern Art Bologna, Slate, Quartz, and many other institutions and publications.

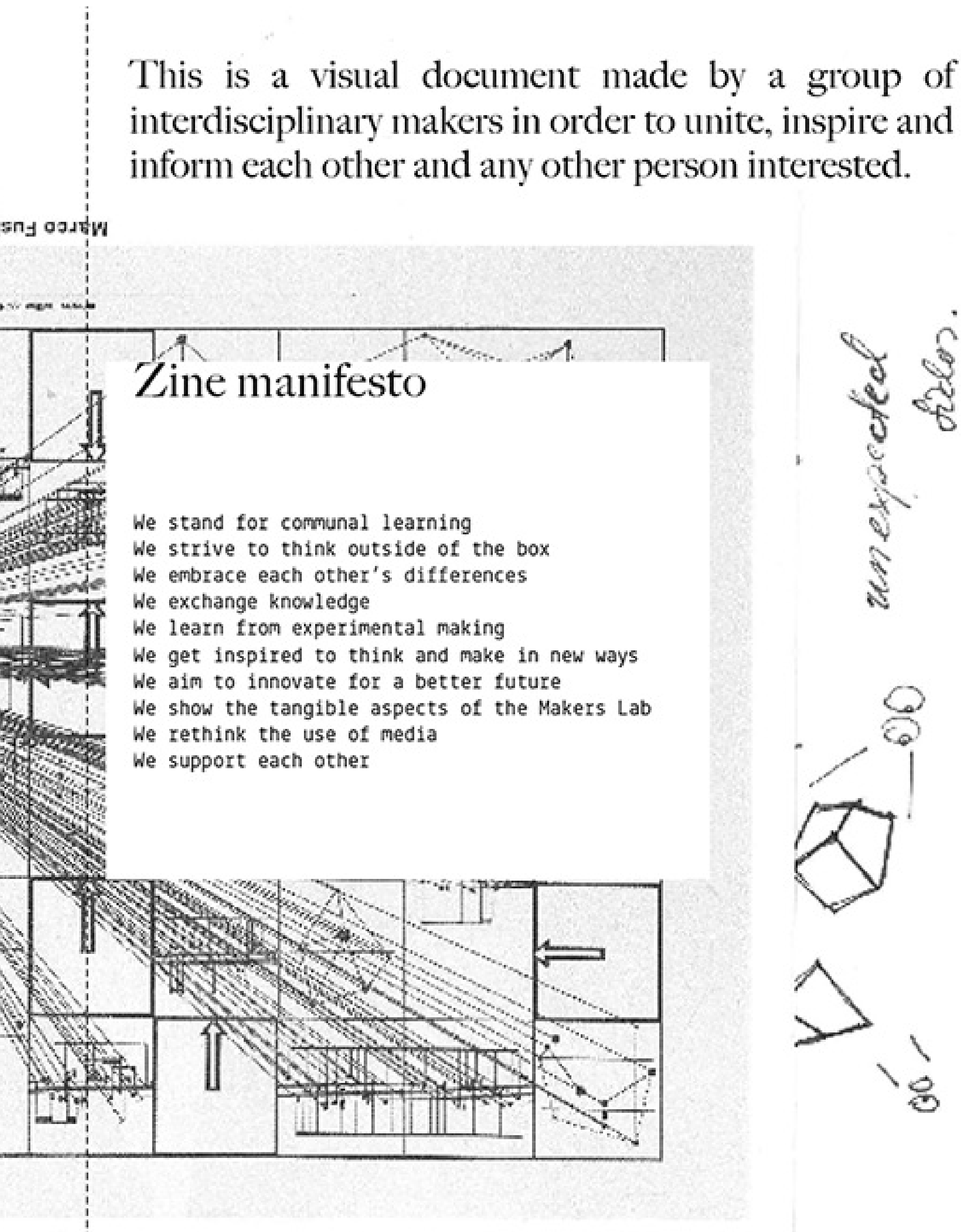
Lucy HG Solomon works across media, continents, and species. Cesar & Lois, her collective with Cesar Baio, received the Lumen Prize in A.I. in 2018. With the League of Imaginary Scientists, she has worked as far afield as Mars. She is Associate Professor of Media Design at CSU San Marcos.

Peter Troxler is a Research Professor at Rotterdam University of Applied Sciences. He studies the impact of digital technologies on temporary and permanent organizations and the emerging paradigms of networked collaboration. Peter holds a PhD from ETH Zurich and has worked in various positions in business, the arts, and academia.

Grace Van Ness is a porn performer, multimedia artist, and graduate student in Communications Studies whose research focuses on the impact of censorship and surveillance on community- and identity-formation. Currently, she is editing a feature-length documentary on the history of sex worker activism, as told by sex worker activists.

Eva Verhoeven is a cross-disciplinarian (artist, designer, researcher, educator...) and Programme Director of Interaction Design & Visual Communication at the London College of Communication. She is interested in the consequences of technological developments and its relays into culture. She is currently exploring the potential of post-human centred design in the context of the Anthropocene. She is co-founder of Supra Systems Studio, which uses critical and creative practice to conduct urgent investigations and demonstrations at the intersection of ecological, political, and technical systems.


Collecting input



This is a visual document made by a group of interdisciplinary makers in order to unite, inspire and inform each other and any other person interested.

Zine manifesto

We stand for communal learning
We strive to think outside of the box
We embrace each other's differences
We exchange knowledge
We learn from experimental making
We get inspired to think and make in new ways
We aim to innovate for a better future
We show the tangible aspects of the Makers Lab
We rethink the use of media
We support each other

Manifesto written by students from the elective semester course Makers Lab: Making as Research at the Amsterdam University of Applied Sciences, 2018: **http://minormakerslab.nl**

MY REPAIR MANIFESTO

REPAIRCAFE.ORG

ACTIONS FOR A REPAIR CULTURE. YOU CAN REPAIR ANYTHING: PRODUCTS, RELATIONSHIPS, ECOSYSTEMS AND EVEN YOUR PERSPECTIVE...

1.

2.

3.

4.

5.

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